

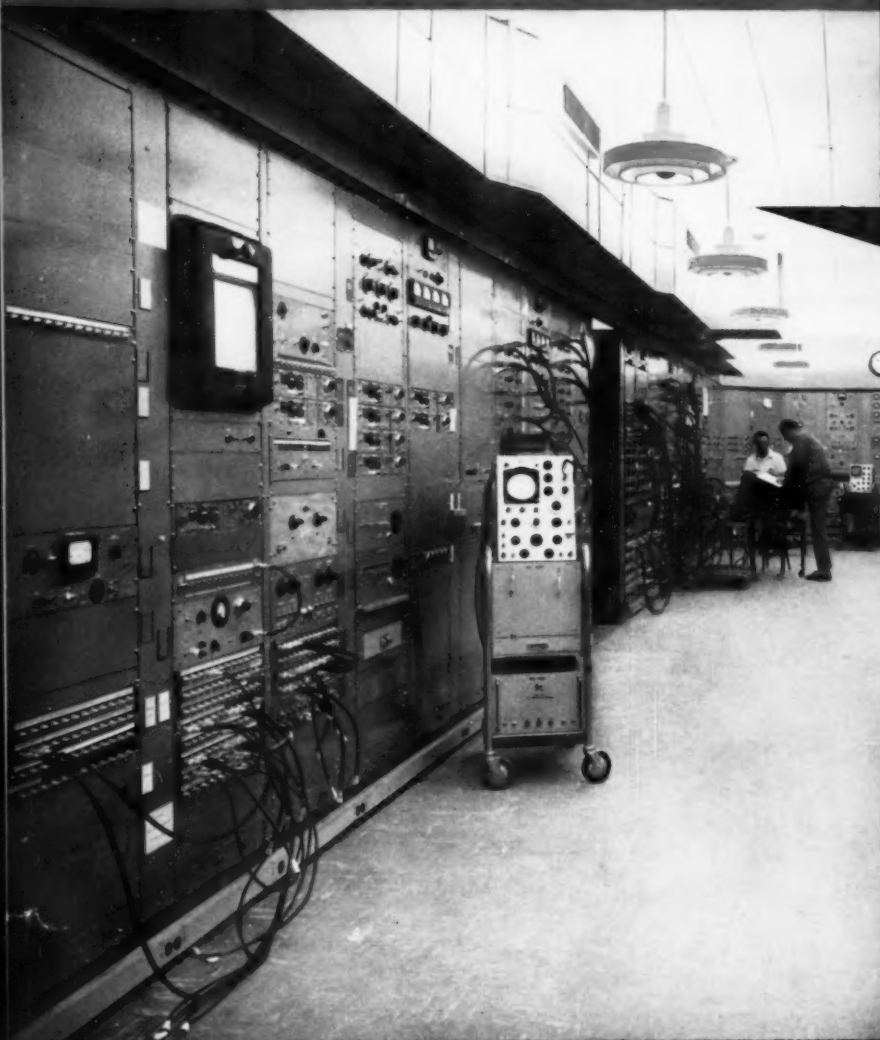
Electrical Construction and Maintenance

WITH ELECTRICAL CONTRACTING

JULY • 1958
PRICE 40 CENTS

HOW complex electrical maintenance procedures are organized, scheduled and carried out in a California cyclotron laboratory installation.

page 73



HOW a Philadelphia arena electrical system was modernized to provide ample trade-show power supply.

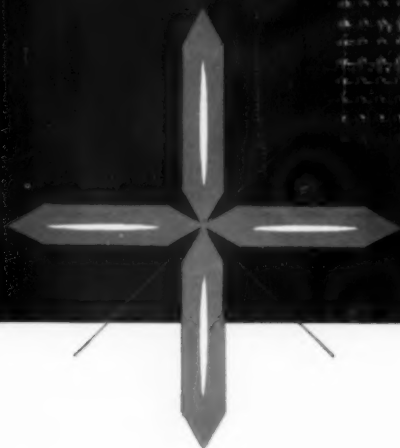
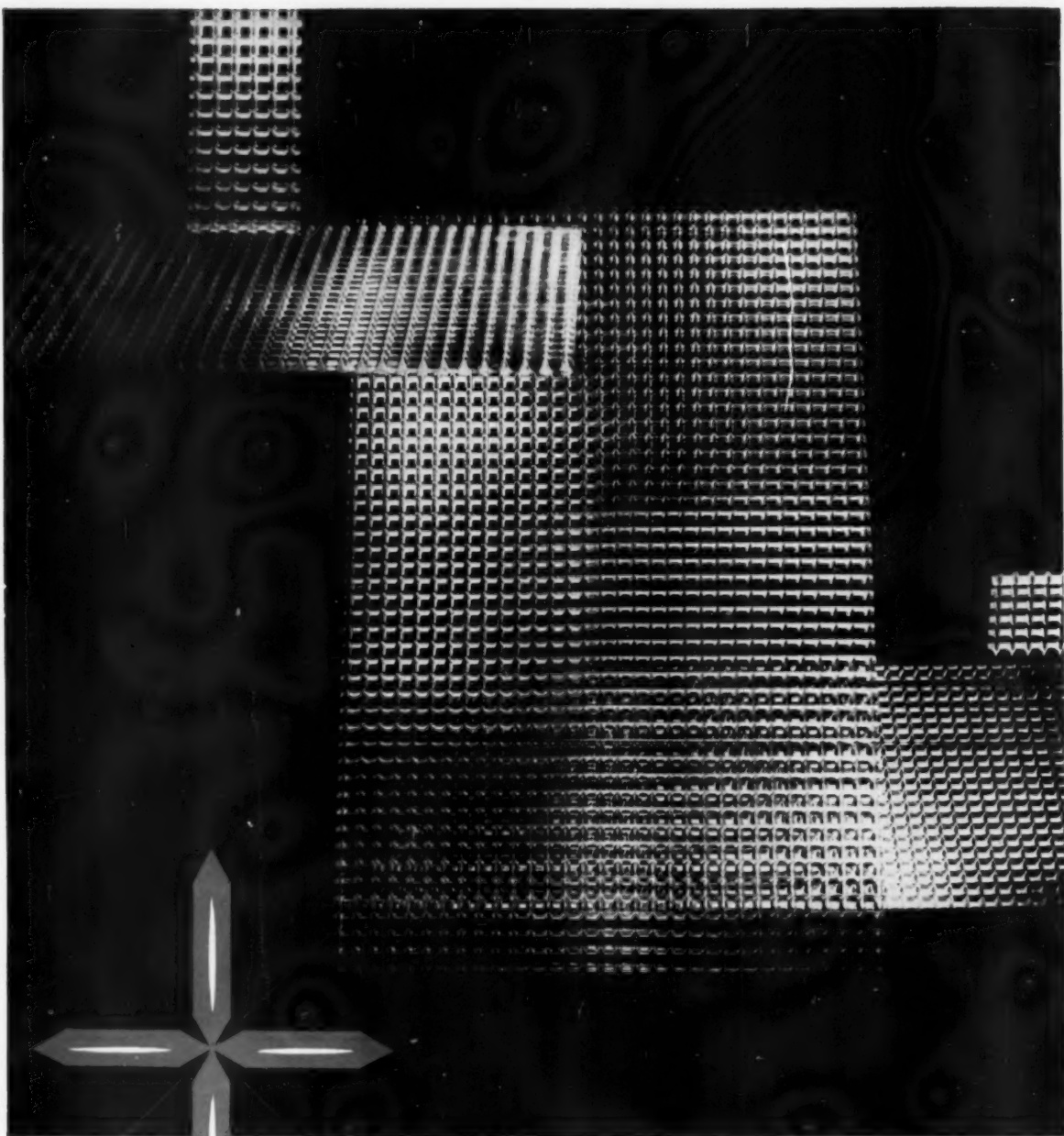
page 85

HOW a 4160-volt primary distribution system and 277/480 secondaries with ties are planned and installed in an Illinois industrial plant.

page 90

A MCGRAW-HILL
PUBLICATION

57TH YEAR



PRISMOÏD GRATELITE*

THE NEW PRISMATIC LOUVER-LENS FOR LIGHTING
FIXTURES BY THE EDWIN F. GUTH CO.,
2615 WASHINGTON BLVD., SAINT LOUIS 3, MISSOURI

TOO BEAUTIFUL FOR WORDS!

*TM Reg. U. S. & Can. Pats. Pend.

SQUARE D's New Aluminum Plug-In Duct with Exclusive -BEAM Design!



4
TIMES
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Square D Company, Dept. SA-27
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Send me Bulletin SD-110 which gives the complete story
of Square D's new aluminum plug-in duct.

Name

Company

Address

City Zone State



SQUARE D COMPANY

Another FIRST by APPLETON

"STN" Sealtite Connectors

for liquid-tight
flexible conduit



Now . . . the fastest, most economical, most trouble-free method of making liquid-tight connections is yours with new APPLETON "STN" Connectors . . . featuring the exclusive wedge adapter!

This wedge adapter tightens almost flush with inner box wall, requires no wrench inside box, and forms a constant pressure, "cold-weld" seal with the box metal! A locking edge on the body of the connector bites into the outer metal of the box so that after the connector is tightened, a positive ground is maintained. The only pressure required to tighten is exerted on the portion of the connector outside the box.

This lasting liquid-tight seal is assured without the use of an "O" ring and ring gasket. There is nothing to deteriorate, only a "cold-weld" metal-to-metal seal which resists vibration and lasts indefinitely!

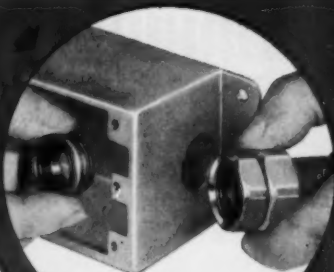
No matter what features you want in a liquid-tight connector . . . single wrench installation ease, more wiring room, positive ground, vibration protection . . . this NEW APPLETON "STN" Connector stands alone in the field! Write or call for complete information today.



Sold Through Franchised Distributors Only

APPLETON ELECTRIC COMPANY • 1701 Wellington Avenue • Chicago 13, Illinois

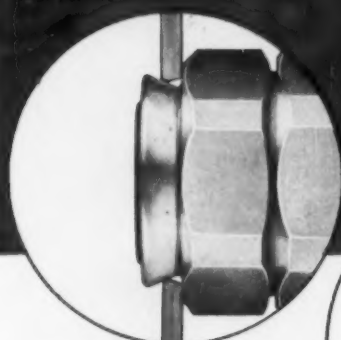
New locking edge on Appleton "STN" wedges were first achieved by forcing into box metal the uniform, high-pressure seal of "STN" wedge adapters . . . assures positive ground.



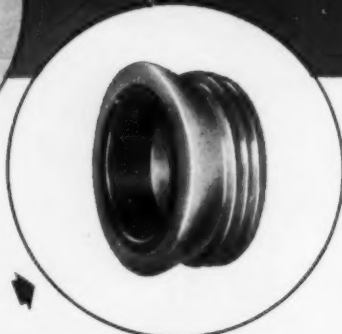
More trouble-free wiring when old-style threads which protrude into box, hampering rigid connections, new wedge adapter requires no wrench inside box.



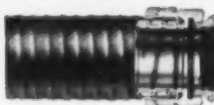
New Wedge Adapter Adapter used for 100% seal at exact constant pressure . . . no vibration, no movement, and no positive ground.



New Insulated Throat! Eliminates the possibility of metal edges damaging wiring . . . perfect for constant vibration installations. Does not reduce inside diameter of throat.



Patented brass ferrule serves as a positive ground . . . excludes liquids and fumes from connection.



Cross section of "STN" Connector which is installed as a unit shows how tapered end of nut compresses ferrule wall . . . seals perfectly and gives positive ground between conduit and connector.

All APPLETON "STN" Series Connectors with the patented brass ferrule and insulator have nothing to come loose, deteriorate, crack, or break! . . . they stay tight! And, since the threaded brass ferrule screws in and crimps on, you have a perfect seal and permanent ground . . . maintaining voltage in ground circuit year after year within 10 millivolts drop. Specify them on your next order. They positively exclude liquids, fumes, chips, shavings and other foreign matter from the connection!

Electrical Construction and Maintenance

with which is consolidated Electrical Contracting, The
Electrict and Electrical Record . . . Established 1901

Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

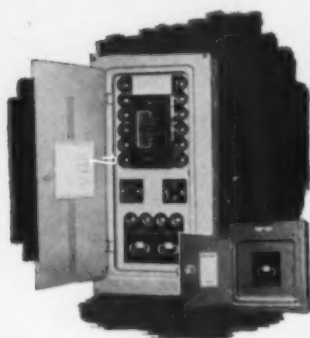
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By C. L. BETTS, Jr.—Electrical modernization program provides high capacity for trade show power supply. New substation, control center, distribution system, lighting installation and air-conditioning equipment restore usefulness and desirability to aging Philadelphia arena.	
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High-level lighting for manufacturing; mechanized method for cable burial; portable-adjustable maintenance lighting; aligning holes in electrical cabinets.	

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to use Cutler-Hammer
fusible service
control**



**137 models
to choose from . . . 30 to
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4330—Single 30 or 60 amp pullout units and units with 4 to 8 plug fuse circuits. Surface, flush and raintight enclosures.

4332—100 amp service parallel connected 60 amp main lighting pullout units with 8 to 12 plug fuse circuits. Two branch pullouts easily added. Surface or flush mounting enclosures.

4334—Series connected 60 amp main pullout and one or two branch pullout units with 4 to 8 plug fuse circuits. Complete line of enclosures.

4335—Parallel connected 90/100 amp service in 31 models. 4 to 12 plug fuse circuits and one to four branch pullouts.

4336—100 amp main pullout, series connected with two 30 or 60 amp branch pullouts. Up to 16 plug fuse circuits. Surface, flush and raintight enclosures.

4338—200 amp service, series connected main and branch pullouts. Up to 32 plug fuse circuits with two branch pullouts and 24 plug fuse circuits with four branch pullouts. Full line of enclosures.

4383—2 to 20 plug fuse panels ranging in capacity from 30 to 100 amps. Available in either flush or surface mounting enclosures.

The Cutler-Hammer line of Fusible Service Entrance Equipment offers 137 different models ranging from a single 30 ampere pullout to a 200 ampere service center with a main pullout, 30 and 60 ampere branch circuit pullouts, and up to 32 plug fuse circuits . . . in your choice of flush or surface mounting and raintight enclosures. A Cutler-Hammer Service Control Unit meets your job requirements best.

Your nearby Authorized Cutler-Hammer Distributor carries a balanced stock of this service entrance equipment. He can give you immediate delivery and save much valuable time you might waste "shopping" for a substitute unit elsewhere.

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Cutler-Hammer Fusible Service Control is tops in economy too . . . priced with the lowest, saves time and effort during installation. And you can depend upon Cutler-Hammer Service Control for longer lasting trouble-free service . . . no nuisance service calls. See your Authorized Cutler-Hammer Distributor now . . . you'll be glad you did. CUTLER-HAMMER Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.



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Vol. 57, No. 7

ELECTRICAL CONSTRUCTION and MAINTENANCE

July 1958

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**Cut costs...
without cutting
corners!**

Specify... GEDNEY CONDUIT BODIES

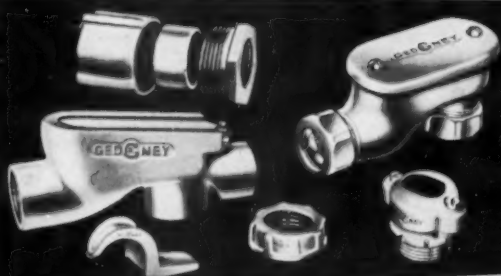
Gedney Conduit Bodies mean lowest installed cost! That's because they are skillfully made of tough, *malleable* iron, then hot-dip galvanized, and finally, they must pass the toughest inspection. Accurate machining and threading assure easiest installation... ruggedness assures longest service life!

THE GEDNEY CONDUIT BODY LINE INCLUDES ALL TYPES—SIZES ½" TO 4"



TYPE LB—Threaded—for heavy-wall rigid conduit. Use them with Gedney entrance fittings, straps, clamp backs to get an *entire* conduit system that is hot-dip galvanized.

TYPE FS—Threaded—shallow bodies for heavy-wall rigid conduit. Hot-dip galvanized finish prevents corrosive deposits—means easier installation, longer life.



SCORES OF OTHER GEDNEY FITTINGS are available for every purpose—all carefully designed, manufactured and inspected to assure economical installation and maximum customer satisfaction.



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Foundry, Factory and Shipping Point: Terryville, Conn.

Sidelights

MAINTAINING CYCLOTRONS

Cyclotrons may seem to be rather distant cousins to the more-familiar members in our family of electrical equipments. Yet, upon analysis, we find countless instances where methods and techniques pertaining to the maintenance of electrical and electronic cyclotron equipment can be profitably related to other types of modern electrical equipment. For example, at the University of California's Radiation Laboratory in Livermore, we discovered that their development of records, training of personnel, identification of components, use of audible and visual alarms, features of basic chassis design, trouble-shooting procedures, remote control and equipment-protective methods constitute a wealth of practical know-how for those whose responsibilities cover maintenance in many of our modern industrial and commercial structures. Moreover, due to the impact that atomic physics is destined to have upon the future of our industry, we believe that this discussion is as pertinently timely as it is practically informative. It is likewise highly authoritative, inasmuch as it was prepared (at our request) under the auspices of the U. S. Atomic Energy Commission. You will find this 12-page report beginning on page 73.

NUMBERING CODE QUESTIONS

Several readers have suggested that items in our "Questions on the Code" department be numbered in some systematic manner to expedite filing and reference. Beginning with this issue, each item will carry a simple key number indicating the date of the issue in which it appears and its place in the sequence of items in that issue. For instance, "Cellular Concrete Floor Raceways" on page 165 is numbered 7-58-3, meaning (7) July, (58) 1958, and (3) third item.

FOR EDITORIAL EXCELLENCE

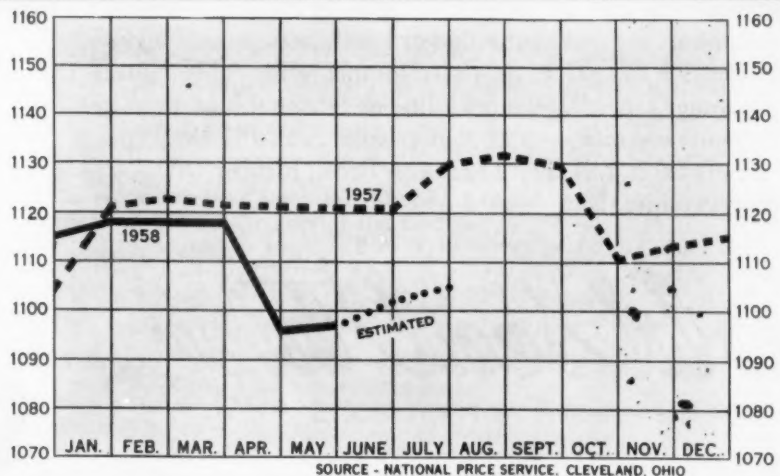
In a nation-wide competition among business publications sponsored by "Industrial Marketing", *Electrical Construction and Maintenance* was awarded a Certificate of Merit for the best single editorial feature during 1957. The award-winning project was "Electric Controls", a special editorial feature in the May 1957 issue. A limited number of reprints of "Electric Controls" are still available at 75¢ each.

ELECTRICAL SPECIFICATIONS

Demands for additional copies of the May Electrical Specification issue took up our entire supply in about three weeks after the issue appeared. Reprints of the Electrical Specifications editorial feature are now available, however, at \$1.50 a copy. Please address requests for reprints to Editorial Department, *Electrical Construction and Maintenance*, 330 West 42nd Street, New York 36, N. Y.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



Tape it easy, Mac!



Gold Seal Tape splices neatly, fast

It has high dielectric strength without bulk — a big advantage in many splicing jobs. It's elastic . . . easy to mold into a neat, thin wrapping. Just what the doc ordered for cramped areas, but we birds see more Gold Seal used for insulating cable splices than any other tape. High service line or terminal box, quality and convenience *talk* — and that's Gold Seal Plastic Tape, in the handy 20 ft. roll. Try it! Jenkins Bros., Rubber Division, 100 Park Avenue, New York 17.

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IN HANDY 20 FOOT ROLLS

Gold Seal FRICTION — RUBBER — **PLASTIC** Tapes . . . Commercial and Specification Grades

Ten 20 ft.
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Handy Pack
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rolls
in individual
metal cans



Washington Report

JULY • 1958

Economic optimism is growing in Washington, as many basic industrial and economic statistics show signs of stabilizing, and as some even turn upward. But this optimism is also tempered by growing fears of a new round of inflation.

Factors giving rise to optimism include: Private housing starts are increasing; Personal income is on the rise; Retail sales continue steady, at about 3% below year-earlier levels; Inventory liquidation continues at a rate of nearly 7½-billion a year; Construction spending continues its increase over year-earlier records; and production has broken its eight-month decline by turning up one point in May.

A new round of inflation, on a vastly expanded scale, which threatens deep dislocations in the national economy, is now the almost unanimous view and fear of many high Government officials, backed in this opinion by leading private economists and bankers. Reasons: Years of heavy deficit financing; Increases in the public debt, Efforts by Federal Reserve to restrain credit; Continued wage-price spirals.

New building construction through May rose \$100 million above first five months of 1957, it was reported by Depts. of Commerce and Labor. Also, construction in May was up seasonally to \$4.1 billion from April's \$3.7 billion, the report showed.

Public construction increased 4% in the first five months from last year's total, reflecting increased spending for highways and public housing. During the same period, private construction outlays trailed the 1957 period slightly (\$12.5 billion vs 1957's \$12.6 billion) due principally to a decline in industrial construction.

Capital spending for new plants and equipment will dip to \$31 billion this year, according to a recent forecast by Commerce Dept. and Securities & Exchange Commission, or 17% below 1957 record expenditures of \$37 billion.

Housing starts in May, at 105,000 units, hit a seasonally adjusted annual rate of 1,010,000, highest since January. This was up from 103,000 starts in May of last year. Liberalized terms for Government-backed mortgages under FHA and VA programs were credited for much of this increased.

U. S. electrical power capacity must be tripled by 1980 to handle projected load requirements for that year, according to a new report on estimated electric power and supply recently released by the Federal Power Commission. An installed capacity of 394 million kw will be needed that year, the report indicates, to handle projected loads of about 343 million kw, and supply total utility energy requirements of 1.9 trillion kwhr. Installed capacity at end of last year was 128.7 million kw, serving peak loads of 114.3 million kw, and supplying total output requirements of 638 billion kwhr.

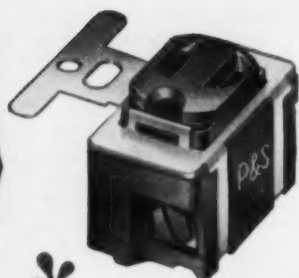
A representative from the electrical industry has been appointed as Adviser to the Director of the Electrical Equipment Division, BDSA, Dept. of Commerce. He is Robert G. Peterson, of I-T-E Circuit Breaker Co., Philadelphia, who will serve a six-month tour of duty without compensation on loan to Government from his company.

Citizens and business get a cost hike of 20% to 50% on mail as of August 1, when postal rates increase on nearly all types of mail. A Congressional bill, tacking 1¢ additional cost each on the 2¢ postcard, the 3¢ first-class letter, the 4¢ air postcard, and the 6¢ airmail letter, was signed by President Eisenhower late in May. Rates on 3rd class mail also go up, some on August 1, and some next January.

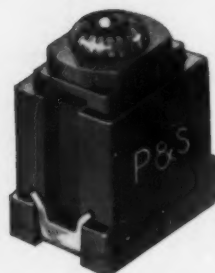
3 NEW

DEVICES

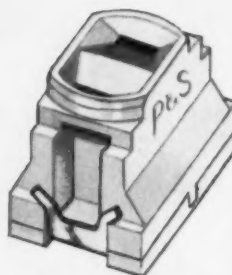
IN THE P&S DESPARD LINE



(No. 1332 Grounding Outlet)
(No. 1432 Ivory)



(No. 1374 Neon Pilot Light)
(No. 1474 Ivory)



(No. 1425 Single Outlet)
(No. 1325 Brown)



Including A NEW GROUNDING OUTLET

Now the wide range of P&S-Despard wiring devices is extended for even greater versatility with the new grounding outlet No. 1332. Nos. 1325 and 1374 have pressure terminals. Like all P&S-Despard units, they're thoroughly tested for long dependable life. A turn of the cam on the Despard Camstrap quickly locks-in combinations of any two or three Despard units. Custom-make your installations to meet the specific needs of your wiring job—with the original and complete P&S-Despard line.

Send for catalog page on
these new devices, Dept. ECM758



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In Canada; Renfrew Electric Limited, Renfrew, Ontario

MAKE THE COMPLETE JOB COMPLETELY P&S



SENSIBLE • HONEST • DEPENDABLE...and ECONOMICAL

Volkswagen Light Trucks have all these virtues...outstanding gas economy...air-cooled engine...no radiator problems...sturdy construction that takes the bumps of rough terrain. Volkswagen has unusual visibility and ease of driving and parking. The Volkswagen Panel Delivery gives electrical contractors a whopping big 170 cu. ft. of usable storage space. It loads from wide side doors, as well as the rear loading door. You can

install a complete test shop inside...save time- and dollar-wasting trips. Top and sides...front and rear give you a bonus in free space for distinctive advertising. But above all, remember: *a Volkswagen costs less to buy, run and maintain.* This we can prove! Sales and Service in 48 states. Look for the Authorized Volkswagen Dealer with this  emblem.

VOLKSWAGEN DELIVERS THE GOODS...FOR LESS!



PICK-UP—1764-lb. payload...45 sq. ft. floor area plus 20 sq. ft. in a lockable weather-tight compartment underneath. Sides and back drop down for easy loading.



KOMBI—it's even more than a Panel Delivery. It converts into a comfortable station wagon in minutes...just by putting the seats back in.

VOLKSWAGEN



"No home is modern without concealed telephone wiring"

—says Mr. F. J. Mallerdino, Builder, of Chicago, Illinois

"I'm putting at least five telephone outlets in every house I build," says Mr. Mallerdino. "They're conveniently located, with the wiring neatly and attractively concealed in the walls. I point them out to prospects, and I advertise them.

"In order to be competitive, a builder has to put as many modern features as he can into the homes

he builds. And I'm convinced that today no home is modern without concealed telephone wiring."

* * *

Your local Bell Telephone business office will be glad to help you with concealed wiring plans. For details on home telephone wiring, see Sweet's Light Construction File, 8i/Be. For commercial installations, Sweet's Architectural File, 32a/Be.

BELL TELEPHONE SYSTEM



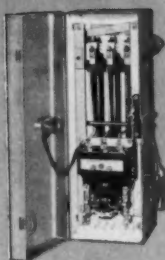
ALLEN-BRADLEY

Quality Reduced Voltage Motor Starters

MANUAL STEPLESS RESISTANCE TYPE

Graphite compression disc resistors provide smooth, stepless starting of polyphase squirrel cage motors—prevent lamp flicker. Operated by a hand lever, the smooth starting of the motor is under the control of the operator.

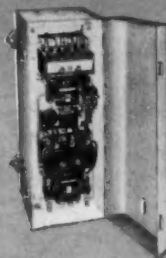
BULLETIN 640



AUTOMATIC GRAPHITE RESISTOR TYPE

Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting. These resistors can be steplessly adjusted for motor and load conditions, resulting in remarkably smooth acceleration of the motor.

BULLETIN 740



AUTOMATIC MULTIPPOINT RESISTANCE TYPE

Meets power company starting current rules on network systems. Resistors are automatically inserted in the line at starting, and are short circuited in steps at definite time intervals which can be adjusted from 1 to 5 seconds.

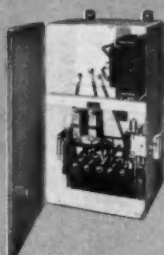
BULLETIN 741



MANUAL AUTOTRANSFORMER TYPE

Recommended where the characteristics of the driven load or power company rules require reduced voltage starting. Double break, silver alloy contacts are standard for air-break starters... copper contacts for oil-immersed units.

BULLETIN 646



AUTOMATIC STEPLESS GRAPHITE RESISTOR TYPE

The ultimate in velvet smooth acceleration of squirrel cage motors. Lamp flicker on network systems used for both power and light is eliminated. The graphite disc resistors are compressed automatically... smoothly and steplessly.

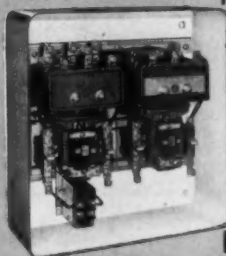
BULLETIN 742



AUTOMATIC PART- WINDING TYPE

For use with squirrel cage motors having two separate parallel stator windings. Two types—Style A, two step starter; Style B, three step starter having resistance in series with motor on the first step.

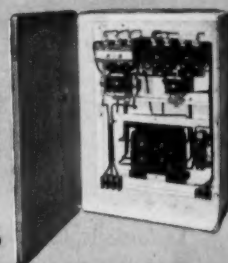
BULLETIN 736



AUTOMATIC AUTOTRANSFORMER TYPE

Utilizes an autotransformer connected in open delta to reduce line voltage for starting squirrel cage motors. Taps are provided on the autotransformer to adjust the voltage applied to the motor.

BULLETIN 746



The Sign of
QUALITY
Motor Control

ALLEN-BRADLEY

MOTOR CONTROL

Allen-Bradley Co., 1315 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

Naugatuck KRALASTIC

Lightweight with heavyweight stamina



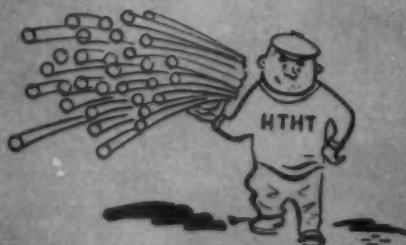
**USE
KRALASTIC PIPE**



Kralastic® Plastic Pipe is impact-resistant. It resists damage from tools, rocks, and the roughest of handling. It's so tough you not only can slug somebody with it—you can actually drive a nail with it.



Kralastic is a favorite where chemicals have to be handled. It handles corrosive liquids in chemical, paper, food-processing and water-treatment plants.



Light in weight, Kralastic is ideal for conduits for electrical wiring (same weight, more wires). Widely used for transporting potable water (N.S.F. approved).



Economical Kralastic stays economical because it lasts so long, is so easily and quickly installed. Make sure the plastic pipe you buy for high-pressure or high-temperature service is made of Kralastic HTHT—for your satisfaction.

Kralastic is the tough rubber-resin material (one of the first to produce plastic pipe) that has proved itself not only in natural gas lines, oil field pipe, and valves of any kind, but in hundreds of other tough applica-

tions, including water transmission lines.

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Flanged Ninged-Cover Wireways and Fittings



Flangeless Screw-Cover Wireways and Fittings

Flangeless Hinged-Cover Lay-In Wireways and Fittings



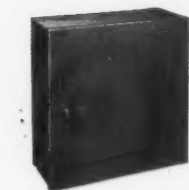
It pays to figure on

KEYSTONE

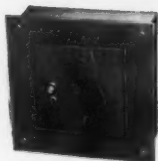
the complete quality line of wiring installation equipment

Whether you're a distributor, contractor, end user—or an original equipment manufacturer, you'll find that Keystone offers you a complete line of quality wiring installation equipment designed to meet your exact needs. U.L. listed wireways and auxiliary fittings, boxes, cabinets and

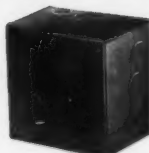
enclosures—plus a full range of "JIC" equipment manufactured to the electrical specifications of the Joint Industry Conference Standards. What's more, all items are stocked at factory and regional warehouses to give you exactly what you want when and where you want it!



Single and Double Door Current Transformer Cabinets



Type "PF" and "PS" Telephone Cabinets



Type "SC" and "FC" Screw-Cover Pull Boxes

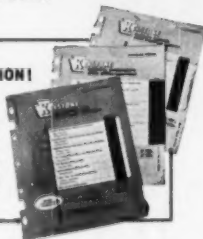


Type "A" Hinged-Cover Surface Cutout Boxes



YOURS FOR THE ASKING WITHOUT OBLIGATION!

Three new easy-to-read, easy-to-use catalogs describe and illustrate the entire Keystone line—contain complete specifications and comparative data. Send for your free set today!



Special facilities for producing custom wiring installation equipment to your specifications. Send print or sketch for prompt quotation.

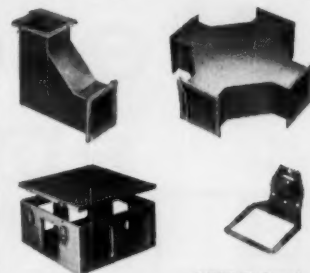


KEYSTONE MANUFACTURING COMPANY

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"JIC" Wireways and Fittings



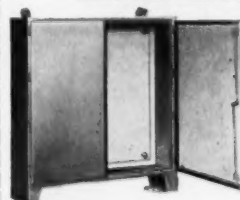
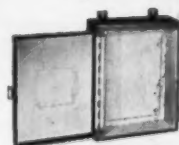
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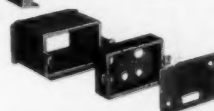
"JIC" Terminal and Pull Box Enclosures



NEMA Type 12 - "JIC" Control Panel Enclosures



Oil-Tight Pushbutton Enclosures



Special Custom Enclosures built to your specifications

3-Way Lighting Merchandiser



It's a smart attractive wall display — Here, two 48 x 33" units make one 96 x 33" wall display. Accommodates up to 22 Virden wall fixtures. To extend it, just add more units.

Available
NOW
Thru Virden
Distributors

Add a ceiling now or later —

Here two 48 x 54" ceiling units are chain-suspended from the ceiling, will accommodate up to 26 Virden fixtures. Excellent for use in smaller rooms or where floor space is limited.



Add legs — and you have a free-standing display!

Now it's a complete lighting center! Displays up to 48 Virden fixtures. Makes selection (and buying) easier, faster.

Packed complete! Shipped to you prepaid!

It's a brand new concept in lighting fixture display! Modular units, designed by Virden, to answer almost every conceivable display problem, to fit any shape room. You can use it singly, or multiples, around corners, in squares, oblongs, literally dozens of combinations. You can suspend it from the ceiling, hang it from the wall, or use it with legs for a free-standing unit.

Smart in appearance, ruggedly made, it displays Virden fixtures perfectly, makes selling easier, faster, more profitable. Each unit is prewired with Bulldog Electrostip. Metal panels in pastel colors are adjustable, slip out for easy fixture installation.

A colorful brochure, picturing and explaining this new merchandiser in detail, is available. See your Virden distributor or write John C. Virden Company, Marketing Division, Dept. ECM, 5209 Euclid Avenue, Cleveland 3, Ohio.



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Member American Home Lighting Institute

THE EASY WAY to keep bends in alignment...
eliminate crooked offsets and saddles...is to use

STEELDUCT

E.M.T. with the BLUE BEND-ALINER stripe

Every length of Steelduct EMT in $\frac{1}{2}$ " to $1\frac{1}{4}$ "
sizes has this built-in "bench mark" to
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blue line from end to end.

The knurled inner finish, smoothly
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To take full advantage of the Blue Bend Aliner
Stripe, use Benfield Benders, with 90° centerlines
and shrink-back marks cast in . . .

or you can mark your present benders
to match. Ask for booklet . . .

"Making Conduit Bends That Fit."

The Blue Line is
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Also EMT elbows, rigid hot dipped galvanized or enameled steel conduit and fittings.



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on every job!**

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There's a
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BULL DOG TAPE goes on fast . . . sticks tight and stays tight. Splices neatly . . . extra strong and non-raveling. High dielectric strength for complete all-round electrical protection. BULL DOG resists weather and moisture . . . stands up longer on the job. Make BULL DOG *your* pet tape!

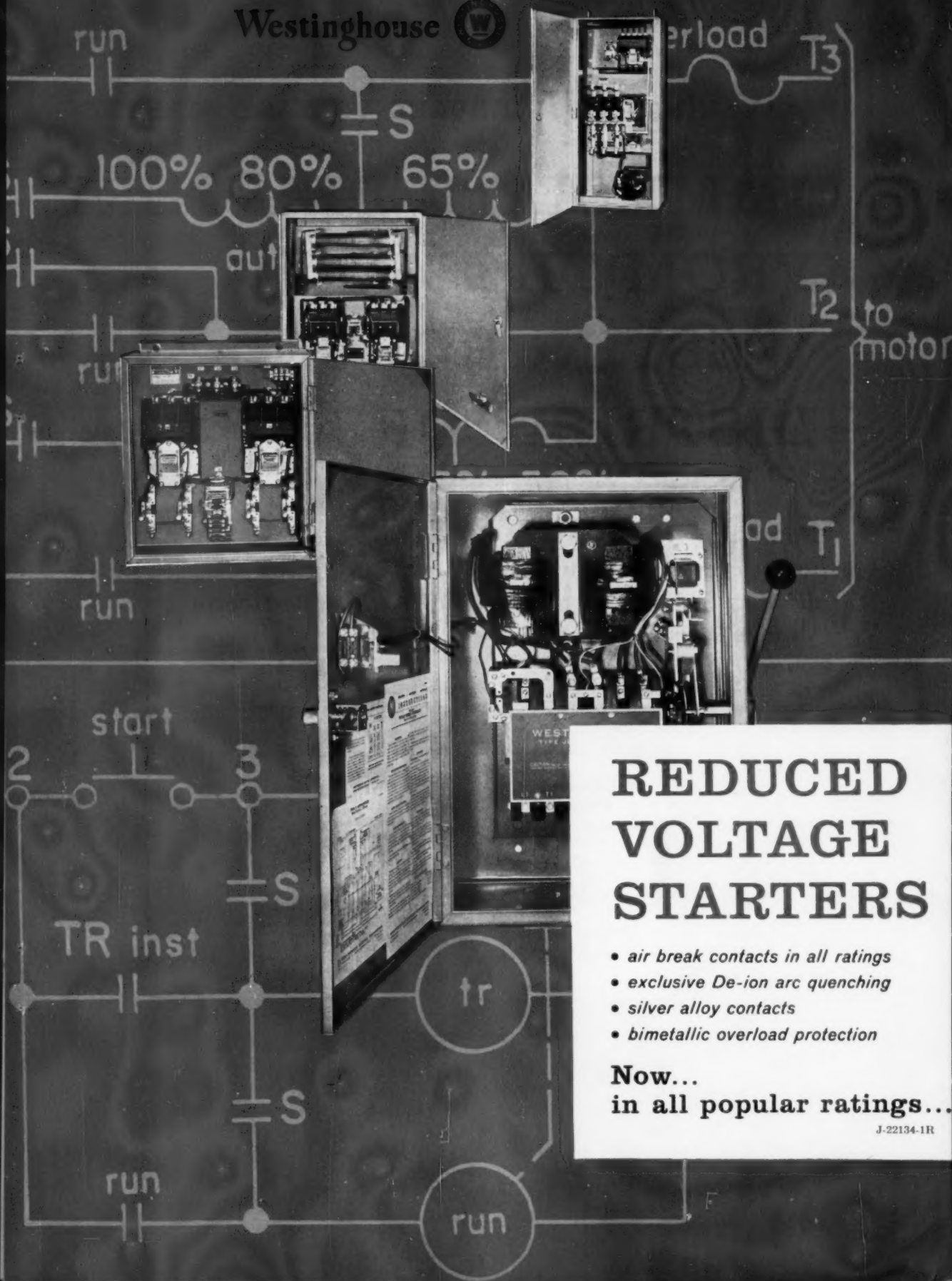
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REDUCED VOLTAGE STARTERS

- air break contacts in all ratings
- exclusive De-ion arc quenching
- silver alloy contacts
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Now...
in all popular ratings...

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Westinghouse REDUCED VOLTAGE STARTERS

IMMEDIATE DELIVERY


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J-22134-2

THREE PHASE 60 CYCLE 220 VOLTS									
HORSEPOWER									
SEE OTHER SIDE FOR AMP VOLTS									
WESTINGHOUSE ELECTRIC CORPORATION GENERAL PURPOSE CONTROL DEPARTMENT Buffalo 3, New York  REDUCED VOLTAGE STARTER SELECTOR				MOTOR CHARACTERISTICS	CURRENT	FULL LOAD AMPS			
						LOCKED ROTOR AMPS			
				AUTO TRANSFORMER	TORQUE	900 RPM FT. LBS. FLT.			
						1200 RPM FT. LBS. FLT.			
						1800 RPM FT. LBS. FLT.			
						LINE INRUSH AMPS			
				TYPE	50% TAP	STARTING TORQUE % FLT.			
						LINE INRUSH AMPS			
						STARTING TORQUE % FLT.			
						LINE INRUSH AMPS			
				OPEN TRANSITION	80% TAP	STARTING TORQUE % FLT.			
						LINE INRUSH AMPS			
						STARTING TORQUE % FLT.			
						LINE INRUSH AMPS			
				PEWELT RESISTOR TYPE	CLASS 10-800	CATALOG NO. C200			
						LIST PRICE \$			
						CATALOG NO. C200			
						LIST PRICE \$			
				FAST WINDING TYPE	CLASS 11-400	LINE INRUSH AMPS			
						STARTING TORQUE % FLT.			
						CATALOG NO. C200			
						LIST PRICE \$			
				PEWELT RESISTOR TYPE	CLASS 11-400	LINE INRUSH AMPS			
						STARTING TORQUE % FLT.			
						CATALOG NO. C200			
						LIST PRICE \$			
				FAST WINDING TYPE	CLASS 11-400	LINE INRUSH AMPS			
						STARTING TORQUE % FLT.			
						CATALOG NO. C200			
						LIST PRICE \$			

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The Westinghouse starter application slide rule is just the "ticket" for easily determining within seconds the exact reduced voltage starter you need for any particular application. Simple to use, with a minimum amount of information required, it will save you considerable time in the accurate selection of all reduced voltage starters.

To obtain your free Westinghouse starter application slide rule, merely phone or write the distributor nearest you whose name and address appear on the following pages. Your free slide rule will be mailed to you immediately.

FROM THESE WESTINGHOUSE DISTRIBUTORS... "OFF THE SHELF" SERVICE FOR ALL YOUR REDUCED VOLTAGE STARTER NEEDS

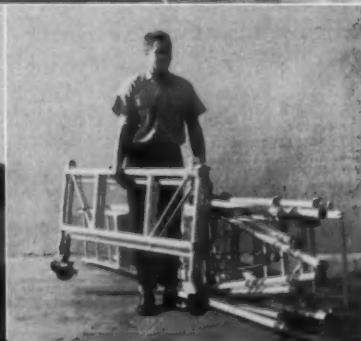
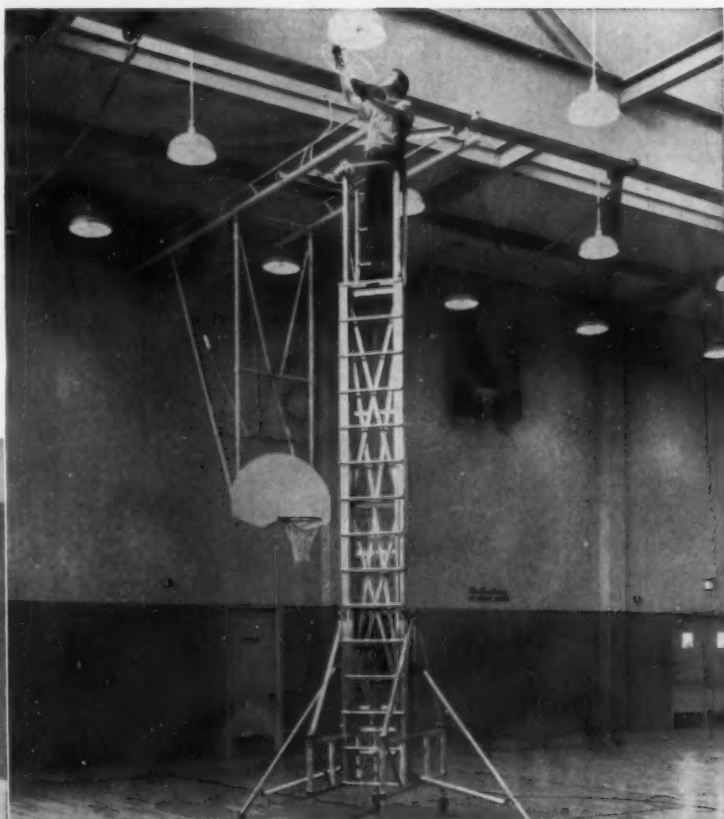
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Lightweight, rapidly assembled by one man. Extends instantly for reaching heights up to 30 ft. Telescopes for rolling under trusses and other obstacles. Adjustable legs for uneven floors or stairways.



Rolls through doorways . . . only 29" wide, telescopes and folds down.

Bridges over auditorium seats.

Separates easily into 3 components for convenient storage or transportation.

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DEPT. 177 • 1013 PARDEE ST., BERKELEY, CALIF.

MANUFACTURED BY
**UP-RIGHT
SCAFFOLDS**

Right off the

Wire

An application of television shows a pilot the image of his plane superimposed on a map of the territory over which he is flying.

An X-ray inspection method for solid cast rocket fuels reveals any cavities or fissures that would interfere with burning.

A new machine at Simplex applies Condex Interlocked Armor over cable cores having diameters up to 4.5".

An electronic guidance system will help river pilots to maneuver long strings of barges around the bends and under the bridges of the Mississippi.

A new facility for advanced research in thermonuclear reactions is expected to generate temperatures in the millions of degrees.

A land-mine exploder has been developed by the Army which will detonate buried explosives without damage to the exploder or the tank that carries it.

A new alkaline flashlight battery is said to last ten times as long as ordinary dry cells and to deliver more power.

A generator-powered flash-bulb holder is about the size of an electric razor. Half a turn of a wheel stores enough electricity in a capacitor to fire the bulb.

A television tube only five inches thick has been developed in England.

A process has been developed for electroplating copper on aluminum. The plating can be tinned, soldered or formed.

A new synthetic rubber is resistant to oils, fuels and solvents and retains its properties at temperatures as high as 400°F.

A new chemical compound slows the growth of any part of a tree without affecting the rest.

A new electronic instrument analyzes the sequence of chemical reactions in the burning of rocket fuels in one ten-thousandth of a second.

A single relay system across Canada from Halifax to Victoria will carry television programs and telephone conversations.

The floodlights at Niagara Falls have been redesigned to give ten times the illumination of the former twenty-five-year-old system with no increase in power consumption.

Further information on these news items and on Simplex cable is available from any Simplex office. Please be specific in your requests.

Among the United States exhibits at Brussels will be an outline of world history for the entire Christian era stored in a computer. Any item can be found in two-thirds of a second and printed in any one of ten languages.

The first digital computer fast enough to evaluate the performance of a missile in flight is said to be twenty-four times faster than preceding models.

A new X-ray technique reduces radiation exposure to a fraction of that now used for diagnosis.

A new truck transmission has twelve speeds in one gear box controlled by one lever.

A new machine can weigh and sort coins at the rate of 18,000 per hour with an accuracy of plus or minus one-fourth of one per cent.

A new desk-top machine covers one or both sides of documents with clear plastic film.

A device for practice in marksmanship shoots, instead of a bullet, a flash of light, which shows on the target.

An ultra-sensitive space speedometer measures acceleration in any direction.



A Simplex Laboratory

At the Simplex plant in Cambridge, six modern, well-equipped laboratories similar to the one shown here are devoted to the never-ending search for new, better materials and methods which result in new, better wire and cable products. Over the years, this program of concentrated, intensive research has brought about a great number of the most important technical advances and product improvements that have made Simplex the leader in the wire and cable industry.

SIMPLEX WIRE & CABLE CO.
Cambridge, Massachusetts and
Newington, New Hampshire

Simplex

Highest quality cables for: Mining
Power & Lighting • Construction
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Signalling

"The American manufacturers of transoceanic telephone cables"



ALLIS-CHALMERS
individually enclosed **LOW VOLTAGE BREAKERS**

*If you're setting
the trip device
or making
inspection...*



Get a long look in a short time

*simply removing
deep front
cover*



The deep cover is the *not-so-deep* secret of safe, easy adjustment and inspection of Allis-Chalmers individually enclosed low voltage breakers. The entire breaker can be inspected without removing it from its position.

For the complete story on why Allis-Chalmers breakers are easy to use, as well as easy to install and maintain, call a local Allis-Chalmers distributor or office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

ALLIS-CHALMERS



A-5564

KOOL KOIL

FLUORESCENT LAMP BALLASTS for RAPID START LAMPS

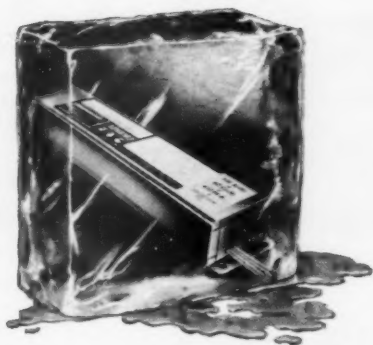
Just as ADVANCE led the way in solving the heat problem with KOOL KOIL Series-Sequence Ballasts for Slimline Lamps, the world's largest exclusive ballast manufacturer now brings you a KOOL KOIL Ballast to end Rapid Start Ballast heat problems . . . and gives you conclusive proof . . . data of actual tests that proves KOOL KOIL superiority.

In a typical 4-lamp surface-mounted lighting unit with metal sides and glass-bottom diffusers under actual operating conditions its performance is amazing:

The maximum coil temperature was 22°C lower than Ballast "A" and 17°C cooler than Ballast "B". The KOOL KOIL maximum case temperature was 10°C lower than any other ballast tested . . . and the most startling fact of all is that the ADVANCE KOOL KOIL Ballast was the only ballast tested that did not overheat the capacitor insulating oil to a temperature exceeding the manufacturer's warranty limit.

The KOOL KOIL maximum condenser temperature in a surface-mounted 4-lamp, completely enclosed lighting unit was only 68°C. Ballast "A" exceeded the 70°C warranty temperature by 12°C and Ballast "B" exceeded it by 9°C.

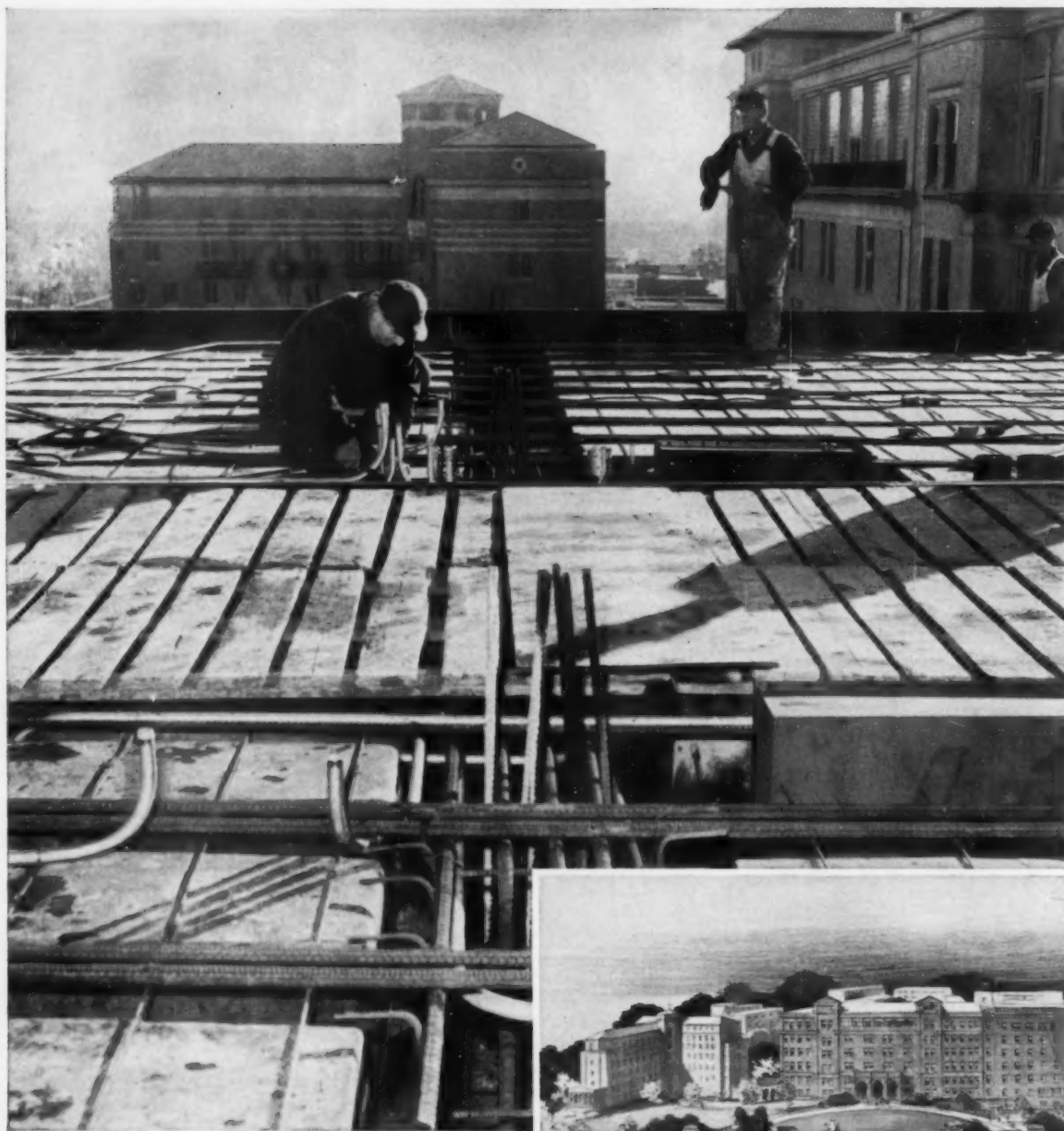
To solve your ballast heat problems, be sure to specify ADVANCE Rapid Start (Cat. No. RS-2E40) or Slimline (Cat. No. RSH-2E75-S) KOOL KOIL Ballasts. Remember, they operate within condenser warranty limits . . . give 15% to 20% more light output . . . last 3½ to 4 times longer than old-fashioned ballasts. Write today for test data and details!



"The Heart of the Lighting Industry"



Republic **ELECTRUNITE E.M.T.** **THE BEST COSTS**



St. Mary's Hospital, St. Louis, Missouri
Architect: Lewis Siberz, Madison, Wisconsin
Engineer: John D. Falvey, St. Louis, Missouri
General Contractor: John B. Gutmann Construction Co., St. Louis, Mo.



offers installation advantages that prove... **LESS INSTALLED**

Republic ELECTRUNITE® E.M.T. is the only electrical metallic tubing that offers you the three installation advantages that prove... the *best costs less installed!*

Republic's ELECTRUNITE E.M.T. features exclusive "INCH-MARKS®", exclusive "INSIDE-KNURLING", and full-length "GUIDE-LINE"... plus, a pull-in, pull-out wiring system designed to meet future electrical expansion requirements.

All reasons why Republic ELECTRUNITE E.M.T. was used throughout the construction of the new St. Mary's Hospital, St. Louis, Missouri.

ELECTRUNITE E.M.T. is produced from highest quality flat-rolled open-hearth steel made in Republic's own mills and carefully inspected to Republic's rigid manufacturing requirements.

Easy and accurate bending is assured when you use ELECTRUNITE E.M.T. with full-length "GUIDE-LINE" and the Republic Bending Tool. Special galvanized finish will not chip, peel, or flake.

Exclusive "INCH-MARKS" are easy to measure. No need to lay a flat rule on the round tube. And, exclusive "INSIDE-KNURLING" of popular sizes makes wire pulling up to 30% easier.

Every length meets Underwriters' Laboratories Standards, Federal Specification WW-T-806 (latest revision), and A.S.A. Specification C.80.3.

Learn more about these installation advantages. Call your Republic ELECTRUNITE E.M.T. distributor... or write direct.



ACCURATE BENDING is assured when you follow the full-length "GUIDE-LINE" and use the Republic Bending Tool. Special galvanized finish will not chip, peel, or flake. All quality features that avoid wasted time and materials.



REPUBLIC ELECTRUNITE E.M.T. meets The National Electrical Code as covered in Article 348 for concealed, open, and concrete construction. Wiring circuits are protected against fire, moisture, and mechanical injury—all reasons why the *best costs less installed* when you specify ELECTRUNITE E.M.T.

REPUBLIC STEEL



*World's Widest Range
of Standard Steels and
Steel Products*

REPUBLIC STEEL CORPORATION STEEL AND TUBES DIVISION

DEPT. C-4345

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Please send me more information about the installation advantages of Republic ELECTRUNITE E.M.T.

Name _____ Title _____

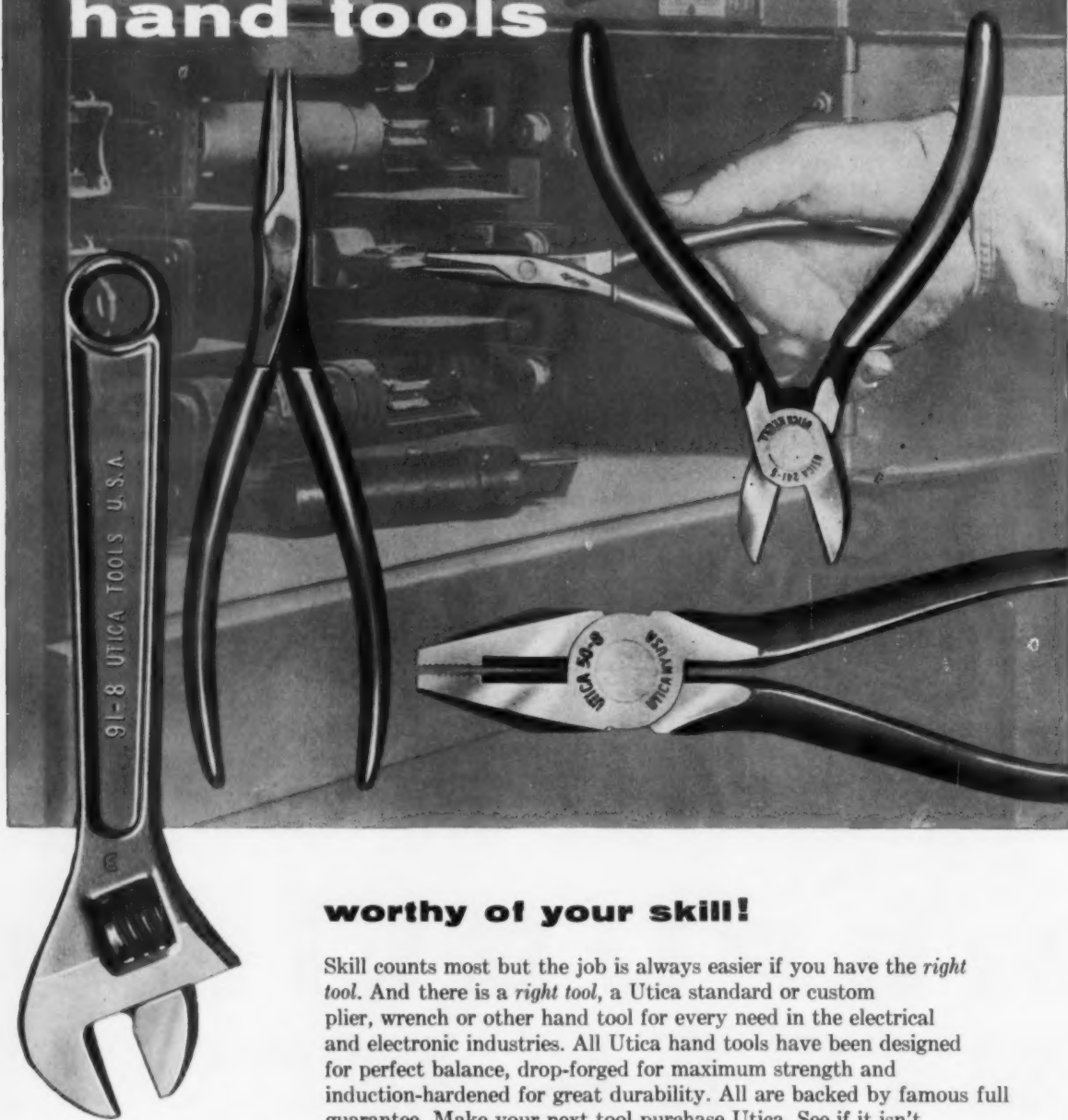
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Address _____

City _____ Zone _____ State _____

UTICA

hand tools



worthy of your skill!

Skill counts most but the job is always easier if you have the *right tool*. And there is a *right tool*, a Utica standard or custom plier, wrench or other hand tool for every need in the electrical and electronic industries. All Utica hand tools have been designed for perfect balance, drop-forged for maximum strength and induction-hardened for great durability. All are backed by famous full guarantee. Make your next tool purchase Utica. See if it isn't the tool you would have designed for the job.

USE UTICA... *the tools the experts use!*

Hallmark of Quality since 1895



UTICA DROP FORGE & TOOL DIVISION • KELSEY-HAYES CO., UTICA 4, NEW YORK

for high voltage
service continuity
on your critical loads
at lower capital outlay—
it's S&C Metalclad
Switchgear!



To get service continuity on critical loads, you need preferred-to-emergency switching of your alternate incoming high-voltage supply circuits, and short-circuit protection and switching on your outgoing high-voltage supply feeders. All of this can be provided in one low-cost package in S&C Metalclad Switchgear, as illustrated.

You even have built-in choices of throwover schemes through S&C's standard automatic transfer panels.

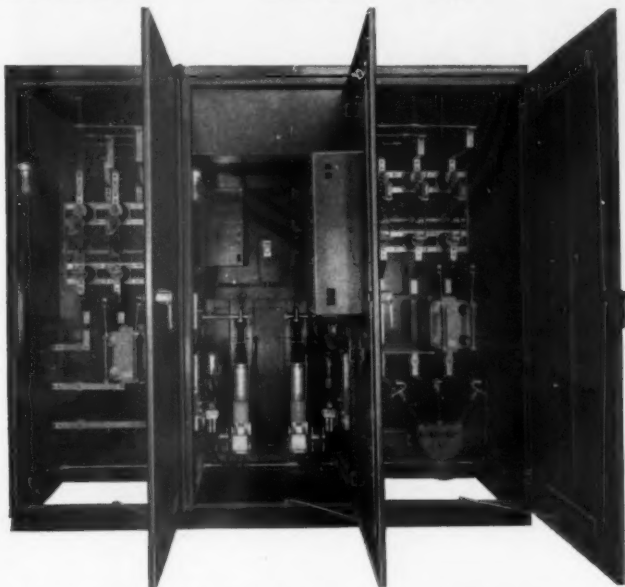
You save two ways:

1. You get metalclad switchgear with job-matched load interrupters and power fuses, in lieu of costly circuit breakers.
2. You eliminate cost of custom designing by using an off-the-shelf transfer panel with built-in options.

No organic insulation to cause corona trouble; porcelain and air only.

High-Speed Automatic Switching.

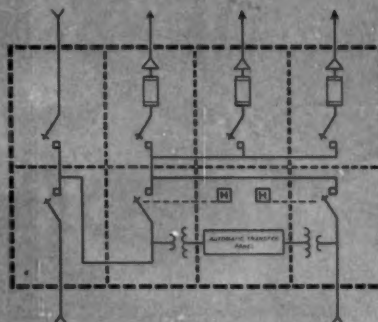
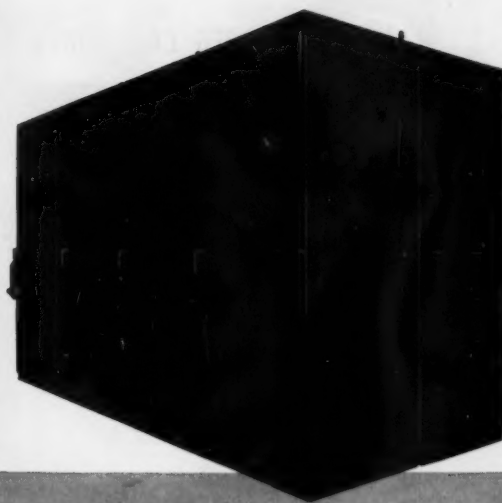
Full-length bulkhead doors; rainproof, with complete access.



Super Durabake finish with galvanized and stainless steel hardware; withstands corrosive atmospheres.

Separate compartment for Moto-Draulic operators; free access and decoupling for checkout.

Strip heaters with adequate venting prevents moisture accumulation.



Schematic for 8-bay switching center unit (above) shows throwover control of 2 of 3 alternative incoming sources to provide continuous service for three outgoing feeders.



S&C Standard Automatic Transfer Panel provides for making either source preferred, for automatic or manual return, for adjustable time delays, for choice of returning in either open or closed transition, and for optional lockout on bus faults.

Power Fuses
Two Operated Disconnects
Open and Enclosed Cables
Fuses (10k)
Transfer
Load Interrupters
Metalclad Switchgear

S & C ELECTRIC COMPANY
4433 Ravenswood Ave., Chicago 40, Ill.

In Canada: S&C Electric Canada, Ltd.
8 Vansco Road, Toronto 14, Ontario



MOLDED CASE CIRCUIT BREAKERS



"Our new automated masonry cement plant is protected against costly shutdowns with I-T-E circuit breakers"

"Since momentary motor overloads can occur in our particular installation, we chose circuit breakers to eliminate the possibility of costly and unwarranted outages," says John R. Allen, designer and project engineer for G. & W. H. Corson's unique new masonry cement plant. "Circuit breakers do, of course, provide complete protection for our motors against actual faults, including protection against single phasing." The Corson Company, America's oldest lime manufacturer, and held in high regard

by engineers for its many developments in the lime industry, appreciates the products and services which I-T-E provides. We think you will too, and, like all who choose I-T-E Molded Case Circuit Breakers, you will appreciate the "extra quality—at no extra cost" which is built into all I-T-E products. Contact your local I-T-E Distributor, or write I-T-E Circuit Breaker Co., Small Air Circuit Breaker Division, 19th & Hamilton Sts., Phila. 30, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.



I-T-E CIRCUIT BREAKER COMPANY
PHILADELPHIA, PENNSYLVANIA

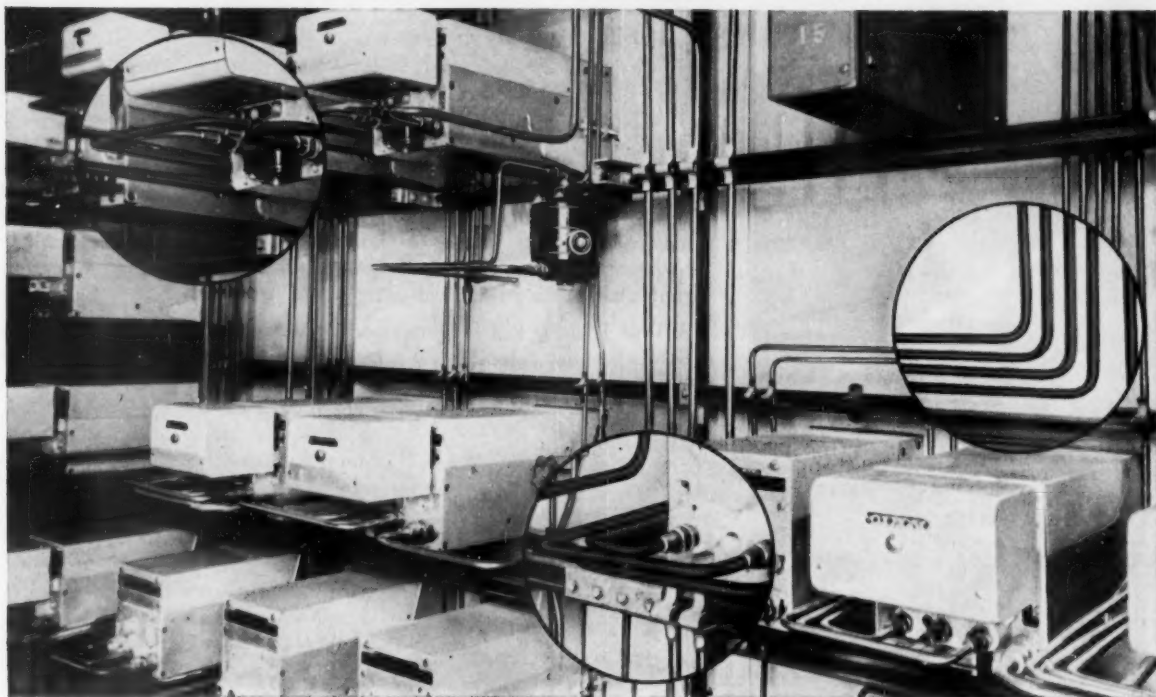
SAFETY m.i. INDUSTRIAL WIRING CABLE

EASIEST TO INSTALL:

Safety m.i. Cable needs no raceway or other protection...trains easily anywhere, even around irregular contours...small diameter...light weight.

TOUGHEST EVER MADE:

Safety m.i. Cable is tough, rugged, and practically indestructible...can be operated continuously at high temperatures...will not burn...resists aging, water, steam, chemicals, oils, and greases.



THROUGHOUT INDUSTRY General Cable's Safety m.i. Cable is in use in distribution, control and lighting circuits up to 600 volts. Leading industries include oil, chemical, steel, automotive, paper, glass, utilities, and railroads. In general applications Safety m.i. offers easy installation, neat appearance, easy training around obstacles, complete

dependability for a long life with no maintenance. In special applications, "m.i." offers the additional advantages of a fully-insulated, self-contained wiring system which eliminates vapor passage. For truly modern industrial wiring specify "Safety m.i. Cable."



Available in 1, 2, 3, 4, and 7 conductor for power and control circuits.

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N. Y.
Offices and Distributing Centers Coast-to-Coast

for quality and service...specify

GENERAL CABLE

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JULY, 1958

WAGNER

Close-Coupled

Transformer

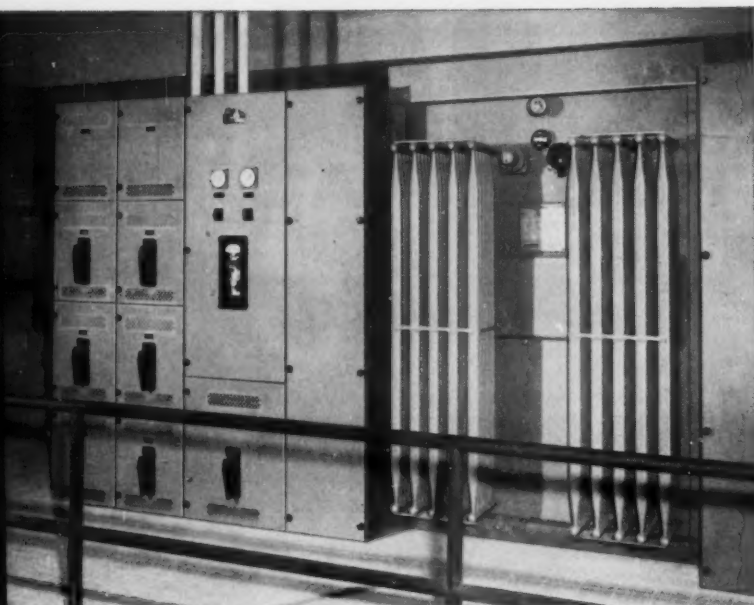
permits

compact

load-center

for TRANE

COMPANY



This Wagner 1000 kva Noflamol close-coupled Transformer is installed in Trane Company's new \$1,250,000 Engineering Building.

One of the many unusual features of The Trane Company's new Engineering Building at LaCrosse, Wisconsin, is a display room for the air conditioning equipment that serves the building. A full glass wall in this room permits visitors to view the Trane CenTraVac water chiller and master control panel, the pump room and the unit substation that handles the power load distribution for the building.

A Type JP 1000 kva Wagner close-coupled transformer was chosen to power the unit substation. Wagner close-coupled transformers fit flush against the switchgear enclosures, eliminating throats and saving space. Connections are made at the bushings on the sides of the transformer. Bushing heights are designed to give ample room for connection to switchgear or busses and eliminate need for special throats to match special switchgear. These noninflammable liquid-filled transformers are available in ratings from 500 through 2000 kva.

Consult your nearby Wagner Sales Engineer about the complete Wagner line of Unit Substation Transformers—both liquid-filled and dry-type. Bulletins TU-205 and TU-214 give full information on Wagner Unit Substation Transformers for industrial power needs. Write for your file copy today.



Wagner
Electric Corporation
SERVING INDUSTRY SINCE 1891

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6413 Plymouth Ave., St. Louis 14, Mo., U.S.A.

WT58-2

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC



Black & Decker Tools for maintenance ... electric power at its saving best!



No. 65 VACUUM CLEANER: handles wet or dry material. Big 1½ hp motor for plenty of suction. Super-flexible hose stretches to a full 15 ft.



6" H.D. BENCH GRINDER: Ruggedly built for H.D. grinding, sharpening, wire brushing or buffing. Full ½ hp constant speed motor keeps jobs moving.



No. 10 SCRUGUN®: Driving screws goes faster; handles up to No. 12 screws. Positive or adjustable clutch; center drive, and handle or pistol grip.



1½" HAMMER: 2200 punch- ing blows a minute makes drilling, chipping, breaking or vibrating go faster, easier. Saves maintenance costs!

Specify the POWER-Built line:

71% of buyers say B&D!

Whether it's a grinder or a cleaner; a drill or a power hammer—over 7 out of 10 industrial purchasers prefer Black & Decker! Experience has told them Black & Decker means *quality*; quality they can depend on to give them years of trouble-free service.

If you have an electric tool need—one illustrated here or any other—do as most people do: think *first* of Black & Decker. That's the name that means a tool to *do the job* and do it for years and years to come. Mail coupon for a free demonstration of the tool you need. **THE BLACK & DECKER MFG. CO., Dept. 1207, Towson 4, Md.** (In Canada: P.O. Box 278, Brockville, Ontario.)



Leading Distributors Everywhere Sell



Black & Decker®

Quality Electric Tools . . . Power-Built for top performance

MAIL FOR FREE DEMONSTRATION

THE BLACK & DECKER MFG. CO., Dept. 1207, Towson 4, Md.

Please arrange a demonstration of your ☐ No. 65 Vacuum Cleaner; ☐ 6" Bench Grinder; ☐ No. 10 Scrugun; ☐ 1½" Hammer.

☐ Send me additional information.

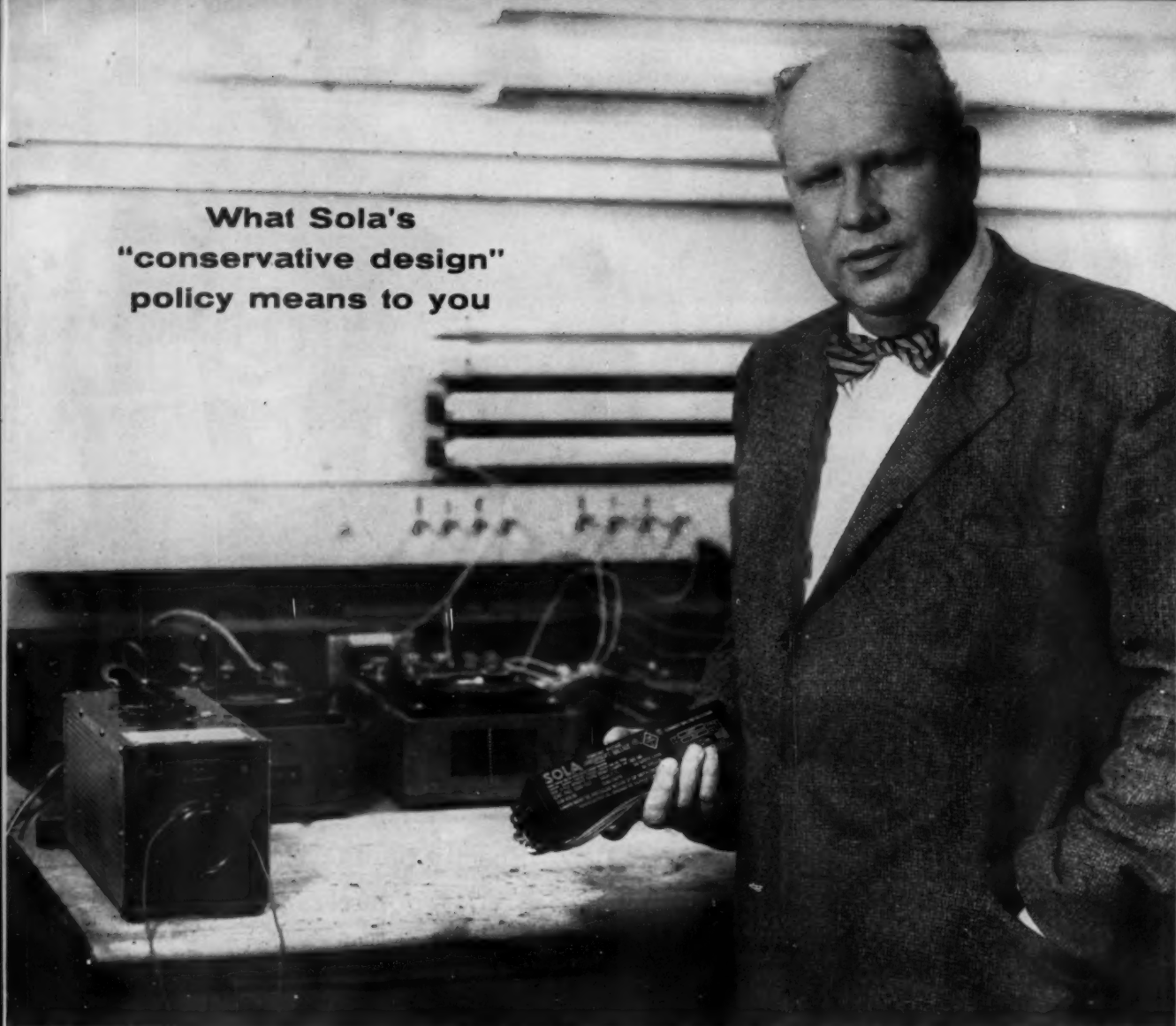
Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

**What Sola's
"conservative design"
policy means to you**



H. U. Hjermstad, Vice President, Engineering, discusses the benefits of "conservative design."

"You pay no premium price for cool, efficient, Sola Fluorescent Ballasts"

There's no need to pay a premium for a fluorescent ballast that will stay cool and still operate lamps at full rated light output. Because of Sola's policy of conservative design, we set product specs that assure *every* Sola Fluorescent Ballast will operate with maximum coolness and efficiency. We've *always* designed and built them to these standards.

Let's look at specifics. As an engineer, I've never been much impressed by charts, tables, and the like, which presume to make comparisons between several brands, but really just "compare" one specific make against some ambiguous make . . . or nothing at all. Perhaps you feel as I do that comparisons should be concrete.

At the right, you'll see a table listing CBM test data from Electrical Testing Laboratories, Inc. on a Sola Ballast for two 40w rapid-start lamps, Cat. No. 624-427. This is our regular, stock ballast, originally CBM certified on Dec. 19th, 1955. We've made no attempt to press comparisons on you. We'd rather that you evaluated the various brands yourself. We think that CBM test reports by E.T.L. are as impartial a source for comparative figures as you can find. See for yourself how Sola stacks up. Use CBM test data on other ballasts or run tests in your own lab. Note the figures in the columns provided. Then judge ballast quality on the facts.

Here is CBM test data on Sola ballasts... make your own performance comparison

CBM TEST DATA by ELECTRICAL TESTING LABORATORIES, INC.

ETL Report Number 90392-M, Date 6/6/57. Tested in ambient temperature of 38°C

SOLA BALLAST Cat. No. 624-427 for TWO 40-WATT RAPID-START LAMPS

Characteristic Under Test	CBM Specification ASA #C82.1	SOLA Cat. No. 624-427		BALLAST X		BALLAST Y		BALLAST Z	
		Values	Sola vs. CBM	Values	X vs. CBM	Values	Y vs. CBM	Values	Z vs. CBM
1. Open Circuit Voltage	Minimum allowable, 256 v. @ 106 v. primary Maximum allowable 300 v. @ 118 v. primary	@ 106 v. primary, 272 v. (average of 4 ballasts) @ 118 v. primary, 296 v. (average of 4 ballasts)	6.2% higher than minimum @ 106 v.						
2. Lamp Current Crest Factor	Maximum allowable, 1.70 @ 118 v. primary	1.57, (average of 4 ballasts on 8 lamps) @ 118 v. primary	7.64% better						
3. Maximum Coil Temperature Rise at Normal Operation	Maximum allowable, 65°C @ 118 v. primary	47.5°C @ 118 v. primary	26.9% cooler						
4. Light Output									
A. @ 118 v.	Minimum of 90% of reference lamp light output @ 118 v. primary	96.3% @ 118 v. primary	7% better						
B. @ 106 v.	Minimum of 75% of 118 v. light output measurement	91.8% @ 106 v. primary	27.8% better						
C. @ 130 v.	Maximum of 12.5% of 118 v. light output measurement	105.3% @ 130 v. primary	12.5% better						
5. Input Watts	None	91.4	Doesn't apply						

test this ballast yourself!

Perhaps you would like to find out first-hand just what this Sola Fluorescent Ballast for two 40-watt rapid-start lamps will do. The Sola Electric Co. will be glad to furnish any qualified organization with sample ballasts from stock. If you have a laboratory set-up for testing fluorescent ballasts, write to us on your letterhead. A Sola sales engineer will contact you and arrange to have these ballasts placed at your disposal. There will be no cost to you, of course, and no obligation. Address your letter to the Manager, Lighting Sales, Sola Electric Co., 4633 W. 16th St., Chicago 50, Illinois.



Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill., Bishop 2-1414 • Offices in Principal cities • In Canada, Sola Electric (Canada) Ltd., 24 Canmotor Ave., Toronto 14, Ont.

SOLA



CONSTANT VOLTAGE TRANSFORMERS



REGULATED DC POWER SUPPLIES



MERCURY LAMP TRANSFORMERS



FLUORESCENT LAMP BALLASTS



There are good reasons why school builders specify lighting equipment with diffusers of PLEXIGLAS® acrylic plastic. Tough, rigid PLEXIGLAS has:

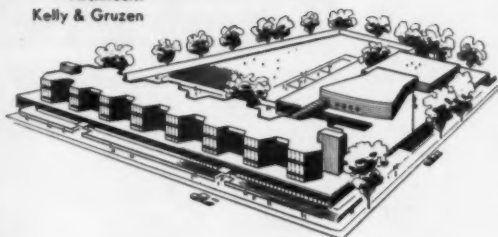
- Freedom from discoloration
- Clean, attractive appearance
- Highest efficiency in transmission and diffusion
- Smooth, easily cleaned surfaces
- Low surface brightness

These advantages add up to *quality* lighting—and today's new schools should have nothing less.

A good example is the prize-winning Clinton Place Junior High School in Newark, N. J., where PLEXIGLAS luminaires are used to light the corridors, library, cafeteria, outdoor walkways, and unique hexagonal classrooms.

Want the names of manufacturers of lighting equipment incorporating PLEXIGLAS? We will be pleased to send them to you.

Clinton Place
Junior High School,
Newark, N.J.
Architects:
Kelly & Gruzen



READING, WRITING AND Plexiglas LIGHTING



Chemicals for Industry

**ROHM & HAAS
COMPANY**

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

Canadian Distributor: Crystal Glass & Plastics,
Ltd., 130 Queen's Quay East, Toronto, Ontario, Canada.

NOW

National Electric building wire

protected with "MYLAR"*

Now National Electric building wire and cable is protected with a polyester tape of "Mylar" film. It's the first to be listed by Underwriters' Laboratories, Inc. "Mylar" replaces the inner cotton braid on cables No. 6 AWG through No. 2 AWG and the rubber-filled cotton tape on size No. 1 AWG and larger of types RHRW, RHW and RHH building wires and cables.



National Electric Products

PITTSBURGH, PENNSYLVANIA

Here are the mechanical and electrical properties that make "Mylar" highly desirable as a component of the cables protective covering—

1. High tensile strength and resistance to flexing, pinching and bending.

	Rubber-filled Tape	"Mylar" Tape
Average tensile strength (unaged).....	3253 psi	12800 psi
After 20 hours in air bomb @ 127°C...	2140 psi	13866 psi
After 168 hours in oxygen bomb @ 80°C	2303 psi	13870 psi
Percent gain in weight after 12 hours immersion in distilled water @ 21°C	32.11%	0.67%

2. The finished product has four times the abrasion resistance of rubber-filled tape and braid.
3. High dielectric strength that imparts a plus safety factor.
4. High resistance to acids, alkalies, moisture and atmospheric oxidation.

Contact your National Electric distributor today. Get the extra value of building wire protected with "Mylar" film.

Don't say any wire—say NE Wire

"Mylar" is Dupont's registered trademark for its brand of polyester film.

ELECTRICAL CONSTRUCTION AND MAINTENANCE JULY 1958
 "Dupont "Mylar"—the toughest plastic film ever made. It has an average dielectric strength of 4,000 volts per mil.

More pre-assembly of Sylvania Lighting Systems saves you installation time on the job

YOU SAVE costly man-hours with Sylva-Lume and Sylvan-Aire, Sylvania's wall-to-wall lighting systems. They're your best assurance of maximum profit per job and the greater cost leeway you need to make job-winning bids.

Sylvan-Aire and Sylva-Lume are engineered and manufactured with your best time and cost interests in mind. Both are designed primarily for suspension directly from fixtures. And equipment is *pre-assembled* in the factory as much as possible for quick, easy installation with a minimum of tools.

Ask your Sylvania Fixture Specialist or Select Distributor for detailed work-saving installation information on both Sylvan-Aire and Sylva-Lume—your most profitable wall-to-wall lighting systems. Or if you prefer, write direct to our Lighting Headquarters for FREE booklets on helpful technical data on both.

SYLVANIA ELECTRIC PRODUCTS INC.
Dept. G40, Lighting Division—Fixtures
One 48th Street, Wheeling, W. Va.

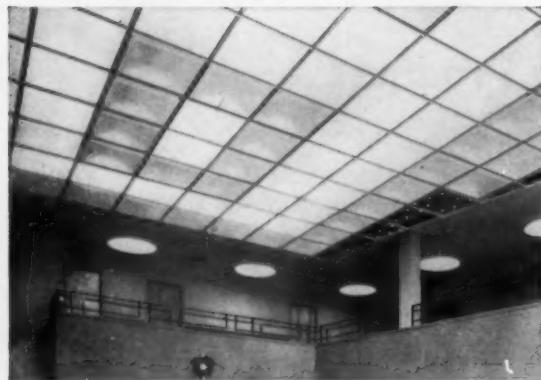
Best fixture value in every price range



SYLVANIA

Fluorescent Lighting Fixtures and Systems

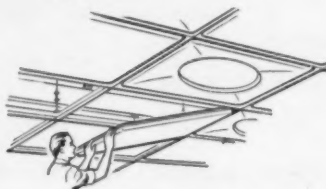
LIGHTING • TELEVISION • RADIO • ELECTRONICS • PHOTOGRAPHY • ATOMIC ENERGY • CHEMISTRY-METALLURGY



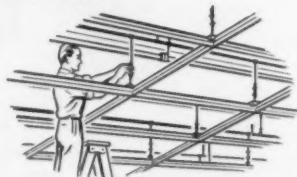
Sylva-Lume, Sylvania's new modular wall-to-wall lighting system, enables you to install over 100,000 different "custom" lighting designs to harmonize with many individual interiors. Perimeter treatment permits fitting in odd-shaped areas.



- 1** New "Outtrigger" fixture (optional) speeds up installation by simplifying wiring, reducing number of supports needed. It cuts costs way down.



SYLVA-LUME... 3 easy steps



- 2** Extruded aluminum grid suspension system is easily hung from fixtures, provides rigid framework of 3-foot squares, simplifies leveling problems.
- 3** Lightweight plastic diffusion panels (white and tinted) are quickly slipped into position on supporting gridwork from below... are easily removed. Optional "acoustic" baffles are "snapped" into place where desired.



Slip in the plastic diffusion panels—for a perfect fit! This completes the final step in the quick installation of Sylva-Lume, Sylvania's modular wall-to-wall lighting system. Panels can be easily removed or changed at owner's discretion.



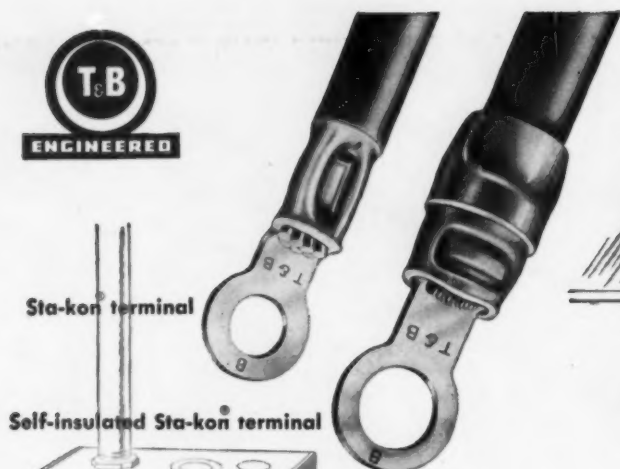
Sylvan-Aire, Sylvania's linear wall-to-wall lighting system, has a minimum of loose parts. That's because Sylvania pre-assembles for you in the factory. Your final product is a modern, neat, classically simple and appealing area-illumination.



SYLVAN-AIRE . . . choice of suspension systems

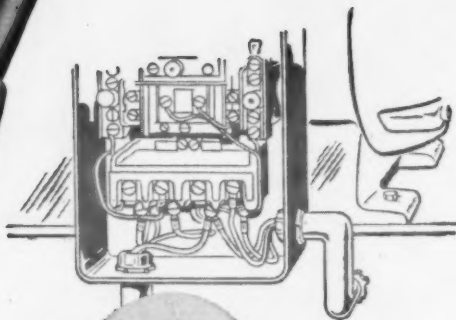
Uni-space a simple, time-saving system, can be used when fixtures are standardized on 3-foot centers.

Vari-Space (lower), a completely flexible variation of the above, is designed to accommodate any fixture arrangement, giving precise lighting levels desired. Takes less time to install than most competitive types!



Sta-kon terminal

Self-insulated Sta-kon terminal



2... in cramped locations

How Sta-kon pressure terminals save wiring time

Sta-kon Junior Terminals are specially designed for fast hook-ups in confined areas, particularly on small blocks or where there is close spacing between barriers. Terminals are one-piece copper alloy with over-all dimensions at a minimum. Sta-kon Junior Terminals far exceed UL requirements for strength and conductivity. Both slotted and ring types available.



1. T & B Sta-kon terminals are easy to install

Just one simple operation with a T & B Shure Stake hand tool or production line tool and the job is done. Terminal and wire, either solid or stranded, are staked, under terrific pressure, to a near solid mass — all in a matter of seconds. Terminal barrel never relaxes its grip. Foolproof tool operation prevents improper installation — connections won't vibrate loose... can't fail under severe stresses.



3... on product assembly lines

Portable or bench-mounted, air or foot-operated tools are available for high-speed production line work. All designed for a minimum of operator fatigue. No flame, heat or fluxing required to install T & B Sta-kon Terminals.

Complete lines available in varied tongue styles and stud sizes with and without insulation grip. Wire sizes 22 to 4/0. Write for Bulletin 61.



LOOK FOR THIS SIGN —

IT'S THE MARK OF AN AUTHORIZED T & B DISTRIBUTOR

The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs.

T326

THE THOMAS & BETTS CO.

INCORPORATED

34 Butler Street • Elizabeth 1, New Jersey
Thomas & Betts Ltd., Montreal, P.Q., Canada

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

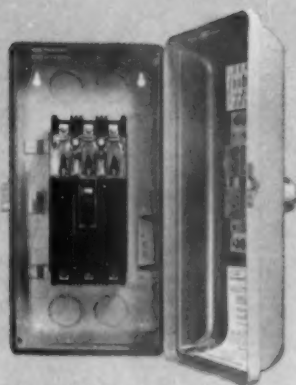
from Westinghouse

LOOK

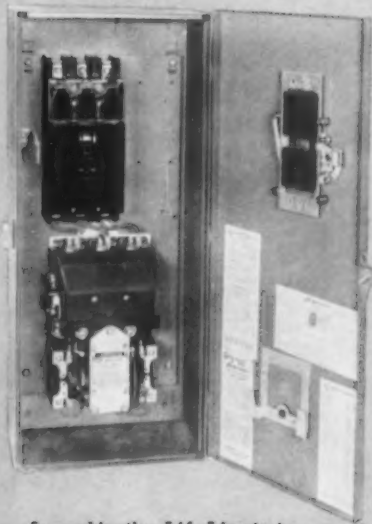
the contacts are visible!

SAF-T-VUE

WORLD'S FIRST BREAKER WITH CONTACTS VISIBLE



In AB-I Breakers



In combination Life-Linestarters

Safe, Sure, Protection

They're calling it "the biggest thing in circuit protection since Westinghouse developed the breaker!" You can see the contacts are open, or closed, through the heat-resistant thermoplastic window. Yet the breaker is still dead-front, with no exposed live parts.

What's more, the transparent window won't cloud during repeated full-load switching or interrupting—won't cloud even on normal overload interruptions.

In case of a high-value short circuit, the Saf-T-Vue breaker window clouds immediately—giving you visual warning of serious trouble on the line. In this rare instance, the transparent window can be easily and inexpensively replaced.

SAF-T-VUE in Westinghouse

AB-I Breakers

Good news for steel mills, automotive plants, all industry—Saf-T-Vue is available in Westinghouse AB-I breakers in sizes F through LM. And you can get them in enclosures for every conceivable application.

SAF-T-VUE in Westinghouse

combination Life-Linestarters

In combination Life-Linestarters*, too! Saf-T-Vue Breakers add one more "plus" to a long line of Westinghouse exclusive features: all front-removable parts; positive De-ion® arc quencher; bimetallic disc overload relay; knife-edge fulcrum that prevents armature sticking or binding; and many, many more—

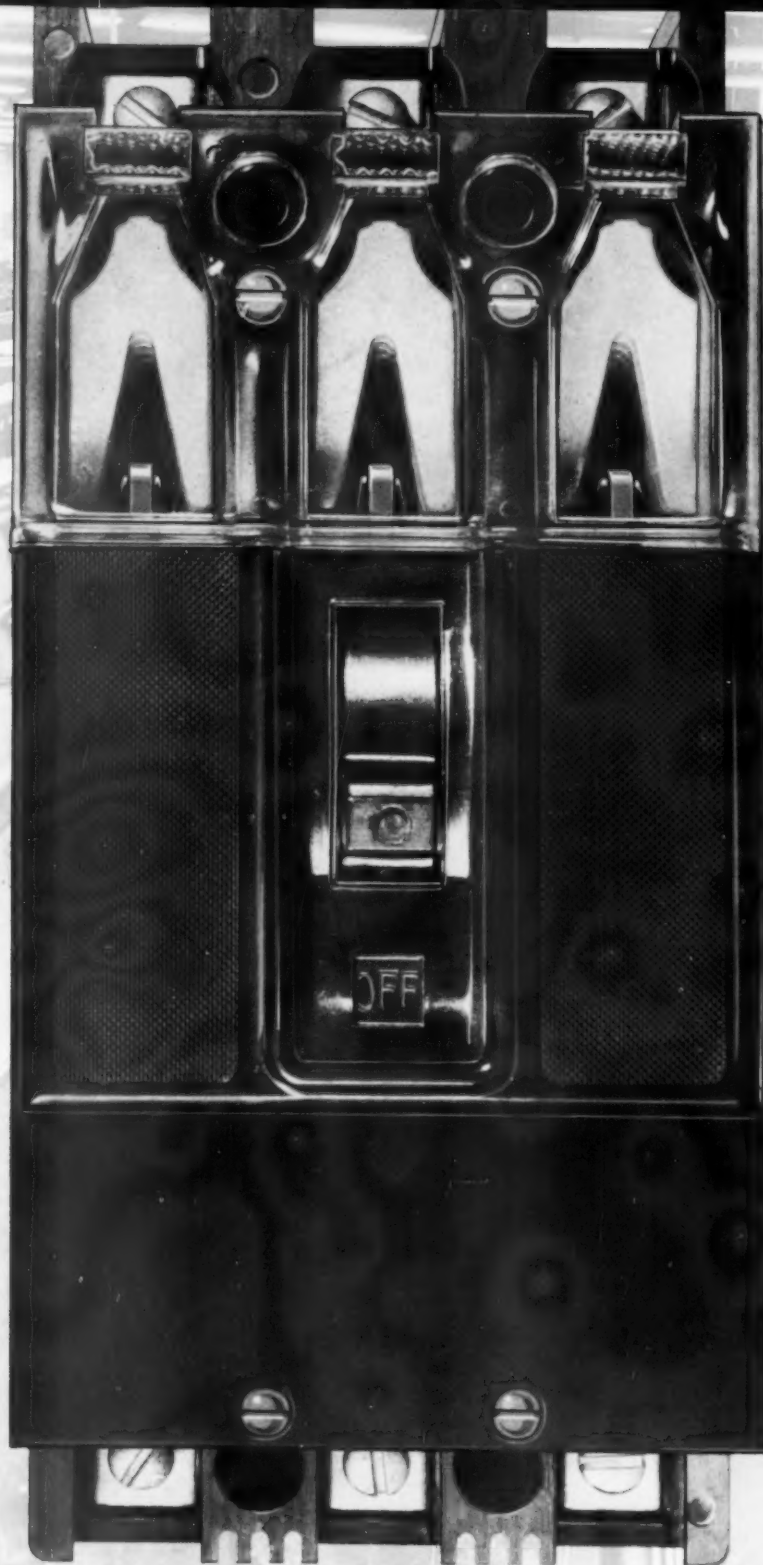
For complete information on this exciting new Westinghouse development, contact your nearby Westinghouse sales office or distributor, or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Penna.

*Trade-Mark

J1-30289

YOU CAN BE **SURE**... IF IT'S
Westinghouse





Westinghouse Electric Corp.
STANDARD CONTROL DIVISION
Beaver, Penna.





Q. *High Cost, "Special" Lighting Job?*

A. *No, Fixtures are Standard — by Litecontrol*

This adroitly planned and handsomely furnished (and illuminated) interior is the main banking floor of the Society for Savings, West Hartford, Connecticut. There is a note of restful charm to the room yet the premises are entirely functional and business-like.

Embedded in acoustic plaster, Litecontrol 6000 Series equipment, with Plexiglas dish diffusers provides the basic lighting (the cone shaped fixtures were supplied by others). The perfectly straight rows of fixtures illuminate without even a suggestion of glare — perfect to work *under and by*. A trigger catch on a removable hinged door provides easy access for servicing.

Like all good installations, this was a "team job" of architect, engineer, electrical contractor, client and ourselves. If you are looking for a lighting equipment manufacturer for your "team" who can help produce results like this *at sensible cost* — look to Litecontrol.

INSTALLATION:

Society for Savings, West Hartford, Connecticut

ARCHITECT:

Jeter & Cook, Hartford, Connecticut

ENGINEER:

Henri van Zelm Associates — Designed by Walter Heywood

ELECTRICAL CONTRACTOR:

The Preston Electric Co., West Hartford, Connecticut

FIXTURES:

Litecontrol No. 6044-RS 4 lamp recessed 2' x 4' fixtures with translucent Plexiglas dish, F40T12/CW/RS

40 watt Standard Cool White Rapid Start lamps.

CEILING HEIGHT:

12' — 0"

INTENSITY:

Average 110 foot-candles in service.



LITECONTROL

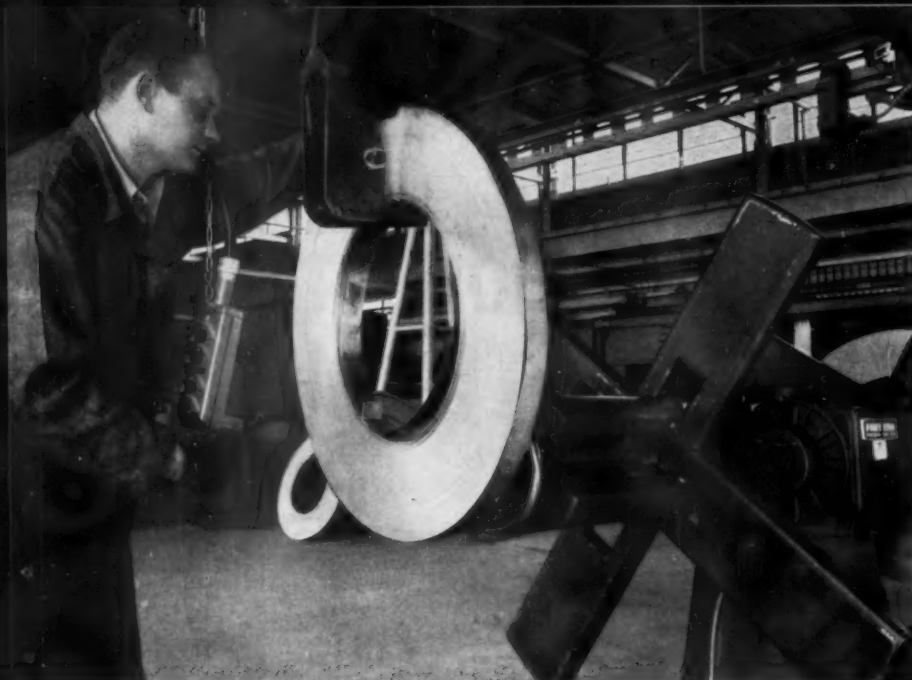
Fixtures

KEEP UPKEEP DOWN

LITECONTROL CORPORATION.

36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALEERS



Here operator loads pay-off arm with a fresh coil of selected, precisely slit steel.

easier-working CIRTUBE* EMT begins right here with the finest steel!



All the care in the world can't make the kind of EMT contractors like working with — unless the steel's right in the first place.

New CIRTUBE EMT is made with the right kind of steel: specially selected, cold rolled, uniform in quality — and with just the right amount of carbon content for ideal working qualities.

But the right steel isn't enough — proper processing is needed, too. Circle's modern processes are designed to keep in the natural bendability of the high grade steels it selects to make CIRTUBE EMT. Result: tubing that can take it with just the right amount of workability.

Proper steel is only one of many reasons why new CIRTUBE EMT helps get faster, better looking wiring jobs.

Next time you order, try new CIRTUBE EMT — you'll like working with it. Now at your Circle wholesaler's.

*Trade Mark

CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO
CORPORATION

PLANTS: Maspeth and Hicksville, N. Y. SALES OFFICES & WAREHOUSES: In all principal cities
RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT

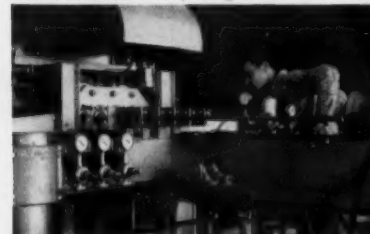
CIRTUBE EMT

Ask for it!



Split-free, bead-free! Induction welded CIRTUBE EMT, left, proves stronger than ordinary EMT, provides easier fishing.

Easy fishing! A baked-on protective coating gives CIRTUBE EMT a built in lubrication for easier wire pulling.



Lifetime exterior finish! Hard galvanized finish for durability; polished satin lustre for lasting good looks.

Automated quality control! Automatic controls assure complete and continuing uniform quality of product.

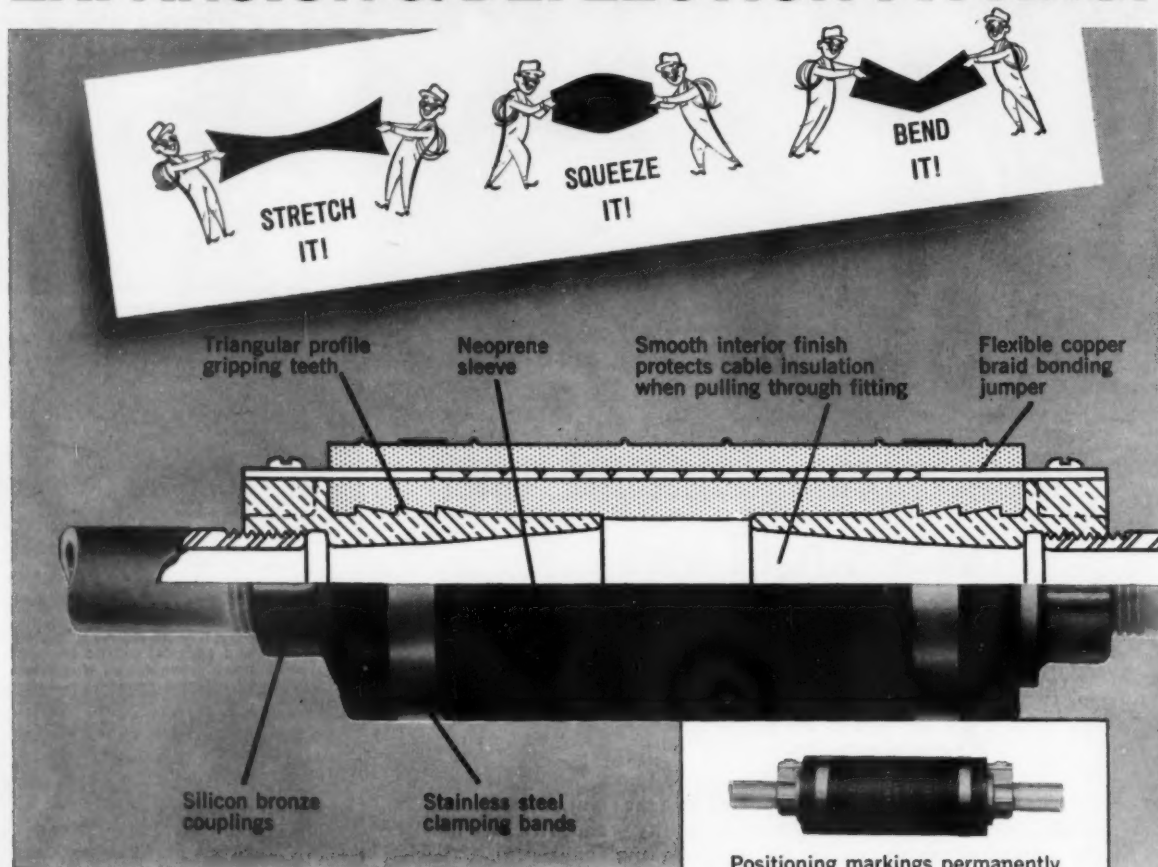


Tight, easily handled bundles! Bright, orange tapes hold CIRTUBE EMT securely for easy handling on and off the job.

Fast, friendly service! Well-known Circle service through a nation-wide network of well stocked nearby warehouses.



For Positive Freedom of Conduit Movement— THE ALL NEW O.Z. TYPE "DX" EXPANSION & DEFLECTION FITTING!*



Here's the newest addition to a long line of O.Z. expansion and deflection fittings — the O.Z. Type "DX"! Of completely new design and construction, it provides fitting features never found before!

The all-new Type "DX" is designed principally to compensate for expansion, contraction, and deflection in conduit across expansion joints in concrete, but it also may be used as a vibration damper.

For more information on this rugged, corrosion-proof, Weather-tight fitting, call your local O.Z. distributor or write direct to the company.

Positioning markings permanently and clearly molded on sleeve assure proper placement of fitting in expansion joint

- Compensates for expansion, contraction, deflection; may be used as a vibration damper.
- $\frac{3}{4}$ " expansion and contraction movement.
- 30° angular deflection from the normal in any direction.
- Corrosion-proof!
- Weathertight!

*Patent Pending



O.Z.

ELECTRICAL MANUFACTURING CO., INC.

262 BOND STREET • BROOKLYN 17, N. Y.

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- POWER CONNECTORS
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- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS



SLIPKNOT PLASTIC TAPE

*solves
the
problem*



*there's waste and extra work in
trying to tear plastic tape . . .*



*but not when you use the exclusive
new SLIPKNOT Cutter, packed free**



*with every 66' roll of new
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Try it today.

*LIMITED TIME OFFER

PAT. PENDING



PLYMOUTH RUBBER COMPANY, INC.

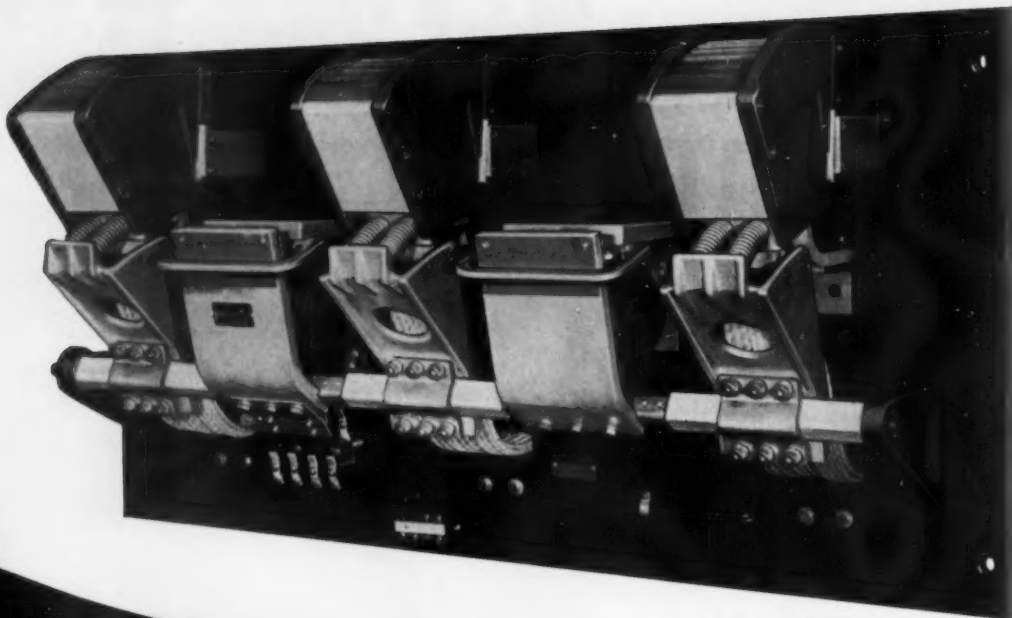
DIVISION 15

Makers of SLIPKNOT FRICTION TAPE

CANTON, MASSACHUSETTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JULY, 1958

49



Rugged* Simplicity

increases contactor life

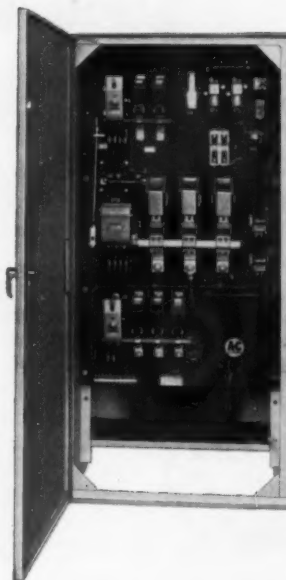
Assures reliability of reduced voltage motor starters

ONE look reveals the clean, balanced design of Allis-Chalmers contactors. Fewer parts eliminate many potentially troublesome areas—mean less wear. Simple, solid construction and high interrupting capacity are positive assurance of reliability.

When you specify reduced voltage starters be sure to get the reliable, long life features provided by Allis-Chalmers contactors. It is these contactors that make all 600 volt Allis-Chalmers Size 4-8 reduced voltage starters the dependable performers they are.

Get all the facts. Call your nearby A-C sales office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

* 7th meaning, Webster's New Collegiate Dictionary, Second Edition.



A-5784

ALLIS-CHALMERS

NOW... double barreled performance

WITH THE ALL NEW **AMP** UTILI-TAP TEAM

The unique double barreled UTILI-TAP connector and matched tools offer a completely new and easy way to secure conductors at both ends of the service drop, at transformers and loop splices. No loose-piece hardware to fumble with, no periodic tightening or arm-wearying tooling. The UTILI-TAP team means maximum performance and long life, with greatest ease of application.

The UTILI-TAP Connector features:

- exclusive double barreled locking crimp—to guard against relaxation under varying load conditions
- tin-plated to resist corrosion and assure optimum electrical connection
- pre-inhibited with non-flow compound to remove oxide from aluminum conductors

The UTILI-TAP Tool features:

- crimping dies are permanently attached to tool head for quick die change
- open type head for easy access to conductor and quick release after application
- portability—lightweight (less than 8 lbs.)
- for wire size range 8 through 4/0 AWG—solid, stranded and ACSR—in all copper and aluminum wire combinations

For more information on the double barreled UTILI-TAP method, write:



American Pamcor, Inc. api

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EXCLUSIVE DISTRIBUTORS FOR **AMP** PRODUCTS TO THE UTILITY INDUSTRY

Control Cable Savings

Begin with Small Diameters

**For New Work
or Rewiring...**



PNR—Polyethylene • Nylon • Rockhide (PVC)

HERE'S THE PROOF WHEN IT COMES TO CONDUIT FILL

No. 12A.W.G. (19/25)		1 CABLE PER CONDUIT				2 CABLES PER CONDUIT				3 CABLES PER CONDUIT				4 CABLES PER CONDUIT			
		Max. Cable Dia. Table 11 N.E.C.	ROCK PNR	Number of Conductors in one Cable	3/64" 4/64"	Max. Cable Dia. Table 11 N.E.C.	ROCK PNR	Number of Conductors in one Cable	3/64" 4/64"	Max. Cable Dia. Table 11 N.E.C.	ROCK PNR	Number of Conductors in one Cable	3/64" 4/64"	Max. Cable Dia. Table 11 N.E.C.	ROCK PNR	Number of Conductors in one Cable	3/64" 4/64"
1/2"	New Work	.450		2-4		.243				.234				.195			
	Rewiring	.479		2-4		.276				.252				.218			
3/4"	New Work	.598		5-7	2-3	.323				.311				.260			
	Rewiring	.636		5-8	2-4 2	.367				.335				.280			
1"	New Work	.762		8-14	4-7 2-4	.412		2-3		.396		2					
	Rewiring	.811		8-18	5-8 3-5	.468		2-4		.427		2-3					
1 1/4"	New Work	1.000		15-19	8-12 5-8	.543		4-5 2-3		.523		3-5 2-3					
	Rewiring	1.070		17-19	9-16 6-9	.618		5-8 2-4		.564		4-5 2-3					
1 1/2"	New Work	1.170			13-19 9-12	.634		6-8 4 2		.610		6-7 4					
	Rewiring	1.248			10-14	.721		8-11 5-7 2-4		.658		6-8 4-5 2					

This is an excerpt from the Rockbestos Control Cable Conduit Fill Chart covering sizes A. W. G. 9, 12, 14. Write today for your free copy. Ask for PNR 1-58.

ROCKBESTOS PRODUCTS CORPORATION, NEW HAVEN 4, CONNECTICUT
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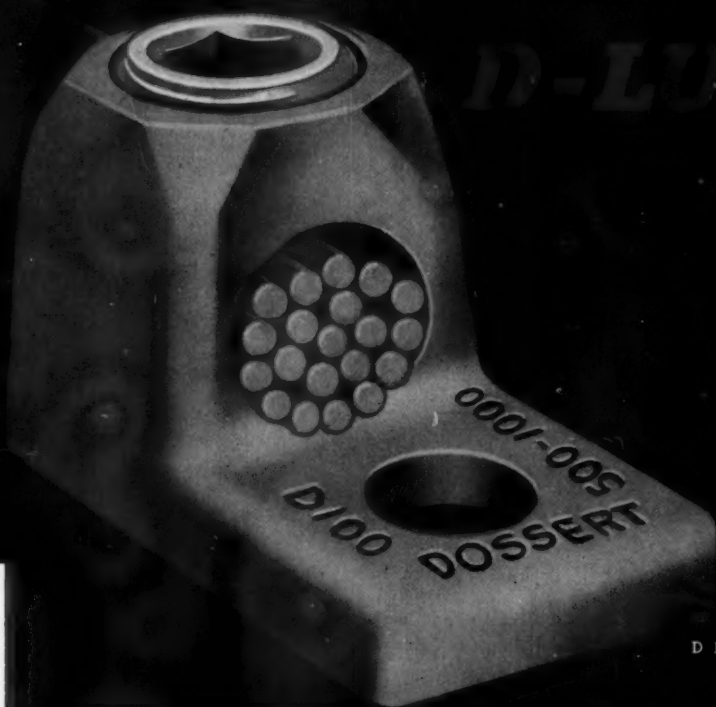


PNR
Small Diameter
Control Cable

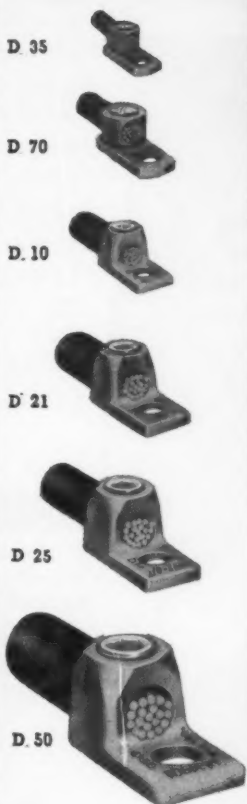
MORE THAN 16,000,000 FEET IN SERVICE

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JULY, 1958

DOSSERT Economy D-LUGS



D 100



Here is a complete and low-priced line of D-LUGS. These connectors are more compact and heavier in weight to insure cooler operation under more severe loads, while being much easier to install. Only seven sizes accommodate from 14 SOL. to 1,000,000 CM.

FEATURES:

- Rugged construction
- Made of high conductivity copper alloy
- Suitable for all purposes
- Variable, each connector takes wide range
- Exceptionally compact
- Reusable

Write for detailed information and prices!



DOSSERT MFG. CORP.

249 Huron Street, Brooklyn 22, N.Y. Representatives in all principal cities
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Sightline® FOR SEEING COMFORT



A TOTALLY NEW INDIRECT LIGHTING SYSTEM

Aluminum extrusions
absorb ballast noise
and dissipate heat

Bonderite treated for
corrosion resistance

UL approved wireway
for 60° circuit wiring

Snap-out plastic
guaranteed against
discoloration

Rigid end plates for
perfect alignment

Patented 45° swivel
suspension system

Heavy gauge,
die-formed,
slotted
reflector

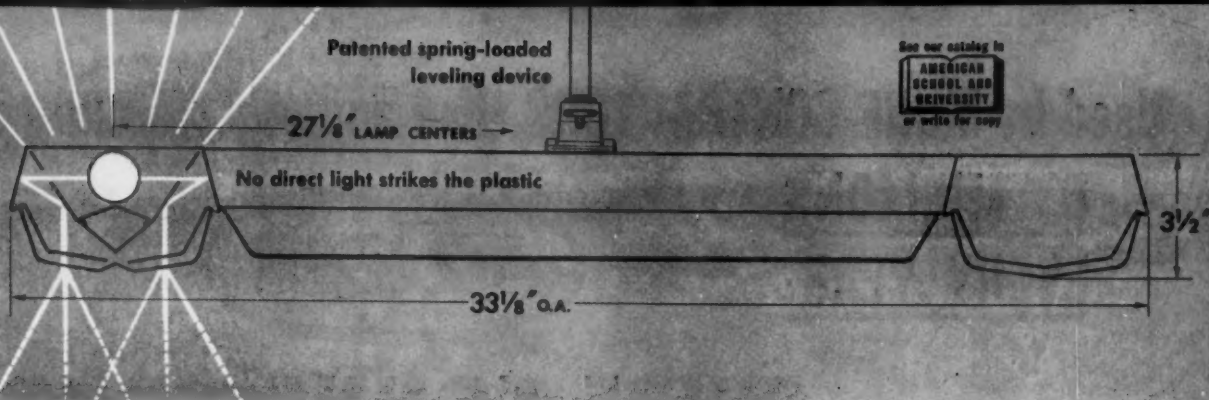
27 1/2" wide
lamp spacing

All-white appearance
blends with ceiling

Snap-out ballast enclosure covers

Patents Pending





A truly integrated, totally indirect lighting system, Sunbeam SIGHTLINE® is engineered to produce high intensity illumination with minimum "overhead" contrasts resulting in the most comfortable, glare-free seeing conditions. This is especially important in areas where visual tasks are critical. SIGHTLINE® excels in every respect to ASA School Lighting Standards. Crisp, clean, airy styling and thin, widely spaced cross channels of the all-white SIGHTLINE® system blends inconspicuously with most interiors. High efficiency of 82%, extremely low brightness of less than 100 ft-Lamberts on ribbed plastic diffuser and minimum maintenance means long-term economy. No direct light strikes the snap-out plastic assuring long life and freedom from discoloration.

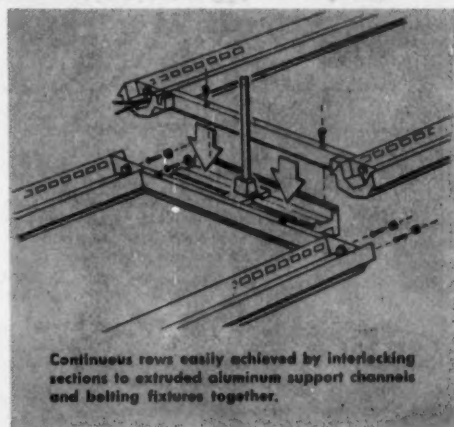
The extruded aluminum cross channels provides more than solid support to the SIGHTLINE® system. They also effectively minimize ballast hum and dissipate ballast heat. A strong, test-proven suspension system with patented 45° swivels top and bottom allows maximum installation flexibility. An aluminum-alloy casting at the bottom incorporates a spring-loaded, self-leveling device and a finger-controlled fine vertical adjustment feature. For utmost simplicity, the SIGHTLINE® is easily ordered by complete rows as required by room size and lighting level desired.

Don't write your next "spec" until you've seen our complete brochure #A-2a.

**FOR MORE EFFICIENT
HEAT DISSIPATION**



QUIETER



Continuous rows easily achieved by interlocking sections to extruded aluminum support channels and bolting fixtures together.

Absolutely no glare, either direct or reflected, comes from SIGHTLINE® illumination. SIGHTLINE® illumination permits maximum visual acuity with no loss of contrasts at seeing task. SIGHTLINE® excels in every respect to ASA School Lighting Standards.

Sunbeam Lighting Company, 777 East 14th Pl., Los Angeles 21, California & Gary, Indiana

Used by **MORE CONTRACTORS** than any other brand--

**BY MILLIONS
EVERY YEAR!**



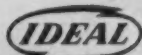
WIRE CONNECTORS

Best testimony to any line of products is who uses them — and why. For over 30 years contractors all over the USA have used more IDEAL Wire Connectors than any other kind — millions more every year. And now they're using more than ever! Why? Most likely because they've proved to themselves that IDEAL Connectors do a better job — are easier to use — and assure wire joints that unfailingly meet every standard for safety, permanence and quality wiring. This eliminates high-cost call-backs due to faulty connections.

Use IDEAL Wire Connectors — most contractors do!



PRE-FABRICATED INSULATION FOR EASIER, BETTER JOINTS



CRIMP CONNECTORS with the

"Wrap-Cap"
(Patented)
THE UNIQUE DIAPER-WRAP
INSULATOR

SAFE . . .

"Wrap-Cap" gives you a joint better insulated than the wire itself . . . all around and between the wires and double-wrapped over ends.

STRONG . . .

Cadmium-plated, double-crimped steel sleeve permanently locks wires into a cool, vibration proof, pull-proof joint with very low electrical resistance.

SIMPLE . . .

No special tool needed.

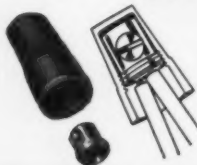


1. Crimp sleeve with IDEAL Electricians Pliers.

2. Apply "Wrap-Cap" and pull tabbed cap between wires and over joint. Job's done!



The 7-ways better screw-on connector with the WIRE-CRUSHING GRIP. Up to 2½ tons of pressure-force from screw-and-lever and wedge action flattens wires and multiplies contact. Just screw them on — like a nut on a bolt! Use new "Wire-Nut" wrench if you like.



Set 'em and see 'em! A screw driver's all you need. Permits visual inspection of every joint. A breeze to re-use when making circuit changes. Solid brass sleeve and set-screw — long-skirt, highest dielectric shell.



All IDEAL Wire Connectors in all contractor sizes are UL listed as pressure cable connectors, for general use (600 V.) in branch circuit and fixture wiring.

SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS
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IDEAL INDUSTRIES, Inc.
1041-G Park Avenue, Sycamore, Ill.

Please send full catalog data on

- ☐ IDEAL CRIMP CONNECTORS ☐ IDEAL "WIRE-NUTS"
☐ IDEAL SET-SCREW CONNECTORS

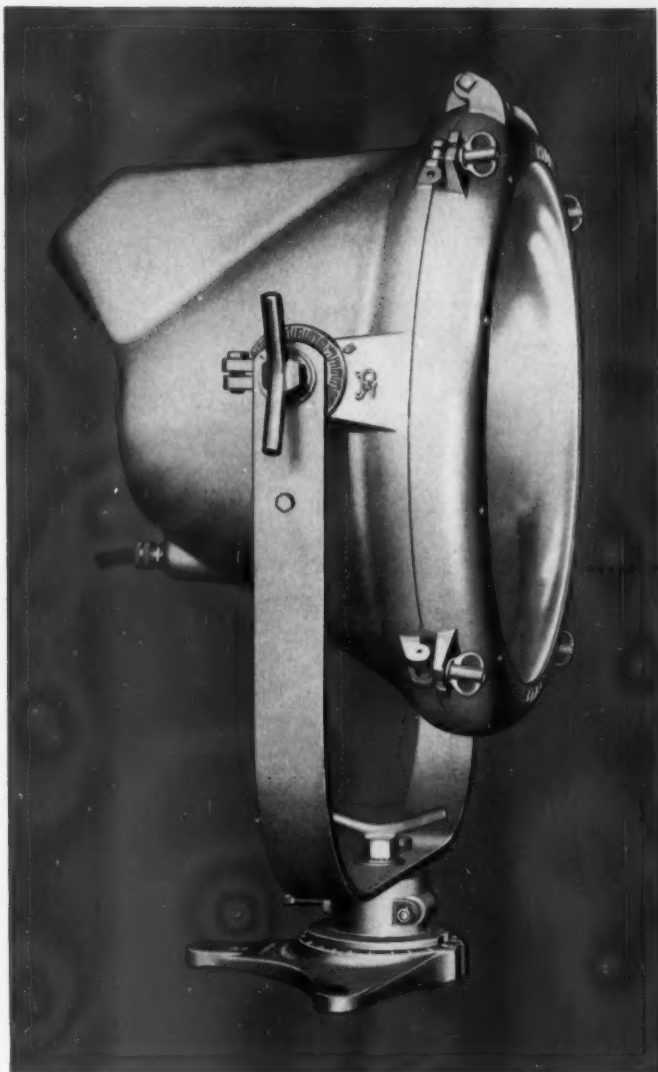
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Company

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City Zone State

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Sold Nationally Through Authorized Distributors. Write for Literature.

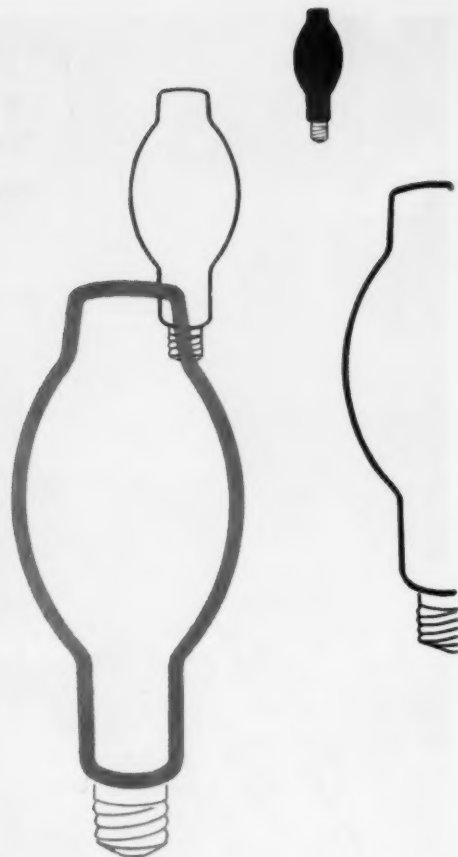
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CONDUIT FITTINGS • MOTOR CONTROLS • SWITCHES • PLUGS AND RECEPTACLES



.....rain-tight
 dirt-tight
 corrosion-proof

The high lumen output and long life of mercury vapor lamps have now been combined with the many advantages of rugged, enclosed, cast aluminum floodlight housings. Since they are corrosion-proof and sealed to protect the interiors from dirt and moisture, the original high efficiency of lens and reflector is retained indefinitely. The result—prolonged economy with exceptionally low maintenance and replacement expense.

Floodlights are available in a wide range of sizes for mercury vapor lamps from 100 to 1000 watts. Choice of specular or diffusing reflectors and five types of lenses provide a selection of beam patterns varied enough to meet the most exacting floodlighting specifications. Enclosures have universal body adjustments and are available with many types of mounting bases.

Send for Bulletin No. 640 containing latest information on operating and color characteristics and operating economies of available mercury vapor lamps; how to select ballasts; short cut method for estimating floodlighting installations with selection tables and sample layout diagrams.



**Mercury Vapor
 Industrial Lighting Fixtures**
 Explosion-proof, dust-tight, and vapor-tight industrial lighting fixtures are available for mercury vapor lamps as well as incandescent lamps.



When choosing a premium power cable . . .

How much choice do you really have?

Cable may *look* alike—but you can find many differences in jackets and insulating compounds. And you want only the *best* cable for your operating conditions.

That's why it's important to choose your cable from a manufacturer who offers you a real choice of modern cable materials.

Full choice of insulating compounds

Only three major companies give you a choice of *either* oil-base or butyl-base insulation. Rome Cable is one of these three and offers a choice of Rozone A (butyl-base) and Rozone (oil-base) insulations.

And, in addition, Rome can offer you a *polyethylene* insulation for high voltages.

You can match your operating needs more closely with cable insulation that puts the emphasis on what you want

most—resistance to heat, moisture, ozone cutting, or any combination of properties. You can be sure of this choice when the cable is made by Rome Cable.

Getting the right jacket

In modern jacket materials, too, the same kind of freedom works to your advantage. You get a choice, with Rome Cable, of Roseal (special flame-retardant polyethylene); Roprene (a Rome-developed neoprene compound for use with rubber insulations); Rolene (polyethylene); and several other high-quality jacketing compounds.

Each has its own advantages, depending on your requirements.

Bring your cable problems to Rome

When you discuss your premium cable requirements with your Rome Cable representative, you can count on his recommending the *right* cable for you. No matter what type of cable you choose, take advantage of Rome's ability to offer you a *real* choice.

For more information on the choice you get with Rome's power cable, contact him now—or write to Department 713, Rome Cable Corporation, Rome, New York.

ROME CABLE
C O R P O R A T I O N

B-M THE ORIGINAL INDENTER FITTINGS

Over 25 Years of Proven Performance



BRIEGEL RED THROAT

- ① Protuding rounded red plastic lip of bushing prevents cutting of insulation—eliminates shorts.
- ② Full thread screws into all conduit fittings. Lip of RED THROAT bushing protects thread from damage.
- ③ Deep dished eight pronged lock nut is easier to drive on—screws flush to shoulder and digs into metal of box for vibration proof positive ground.
- ④ Two quick squeezes with The Briegel Indenter and BM All Steel Indenter Fittings are set forever. Metal is pressed into metal for permanent installation and positive ground.

Permanent locked-in bushing insures smooth burr-free raceway for easy fishing. No extra work.

BRIEGEL METHOD TOOL

CAT. NO. 607 PAT. PEND.

NEW POCKET SIZE INDENTERS

Just 10" long, these new patented compound leverage indenters are only plier size. Lighter to carry and easier to use—the leverage does the work. No. 607 for 1/2" and No. 608 for 3/4" fittings.

BRIEGEL

METHOD TOOL COMPANY

GALVA, ILLINOIS

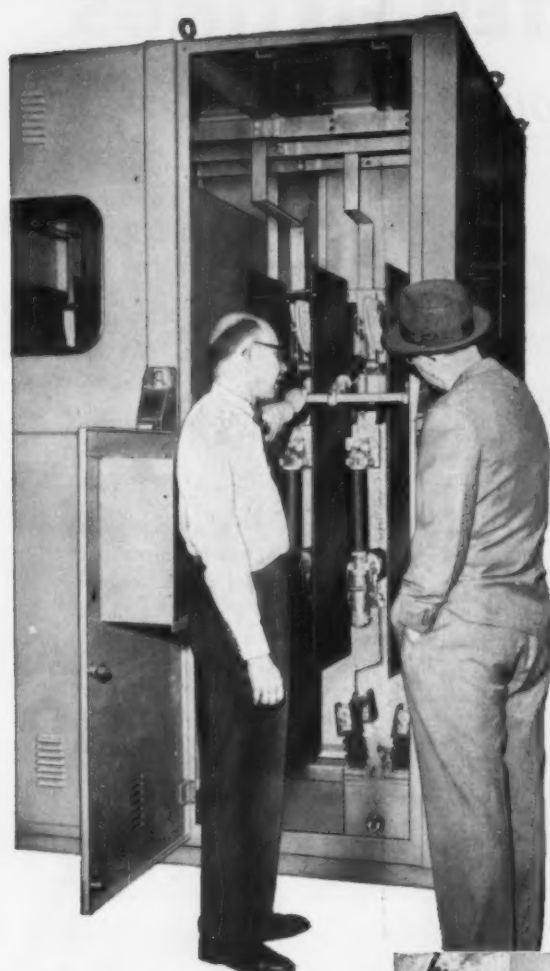
All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406,



ALL BRIEGEL FITTINGS ARE U.L. APPROVED AS CONCRETE-TIGHT



POWER SWITCHING CENTERS



RATINGS—Fused HPL-C Interrupter Switches

up to 14.4 kv (110 bil)
600 amp (40,000 mom)
1200 amp (60,000 mom)

RIGHT—Tog-L Snap operating mechanism, featuring "Ovr-Centr" spring actuator—optional, but important to safety in closing.



"...and HPL-C switches close in on moderate faults"

SAFE CLOSING RATINGS Asymmetrical 3-phase kva values

Nom. Voltage	Direct or Chain Drive	Tog-L Snap, non-current limit fuses	Tog-L Snap, current limit fuses
2,400	50,000	150,000	250,000
4,800	75,000	250,000	500,000
7,200	75,000	250,000	750,000
12,000	75,000	250,000	1,000,000
13,800	75,000	250,000	1,000,000

SAFETY FEATURES—(1) HPL-C closes in on special heavy closing contacts, outside the interrupter—thus preventing damage to the interrupter switch when closing in on moderate fault currents; (2) High velocity "Ovr-Centr" blade closing (and opening) with the Tog-L Snap operating mechanism—an optional feature, providing additional safety, important especially during the closing operation. For safety's sake, specify these important features.

TESTS—Switches have actually closed against moderate 3-phase fault currents at 4.8 and 13.8 kv—proving that the HPL-C offers a high degree of protection. Ask the I-T-E representative to give you the performance facts. See how you can save on installation costs with standardized engineering; on operating costs by preventing costly shutdowns; on maintenance costs through simple inspection and up-keep requirements and accessibility to equipment.



I-T-E CIRCUIT BREAKER COMPANY
R&IE EQUIPMENT DIVISION • Greensburg, Pa.

FOUR FEATURES FOR OPERATOR SAFETY

1 STORED-ENERGY
CLOSING

2 SPRING-OPERATED
OPENING

3 TIME-DELAY
INTERLOCK

4 DEAD-FRONT
CONSTRUCTION

Greater safety with

General Electric **ROLLOUT**

Switch and Fuse Equipment

Optimum safety is built into General Electric Switch and Fuse Equipment with stored-energy closing, spring-operated opening, time-delay interlock, and dead-front construction.

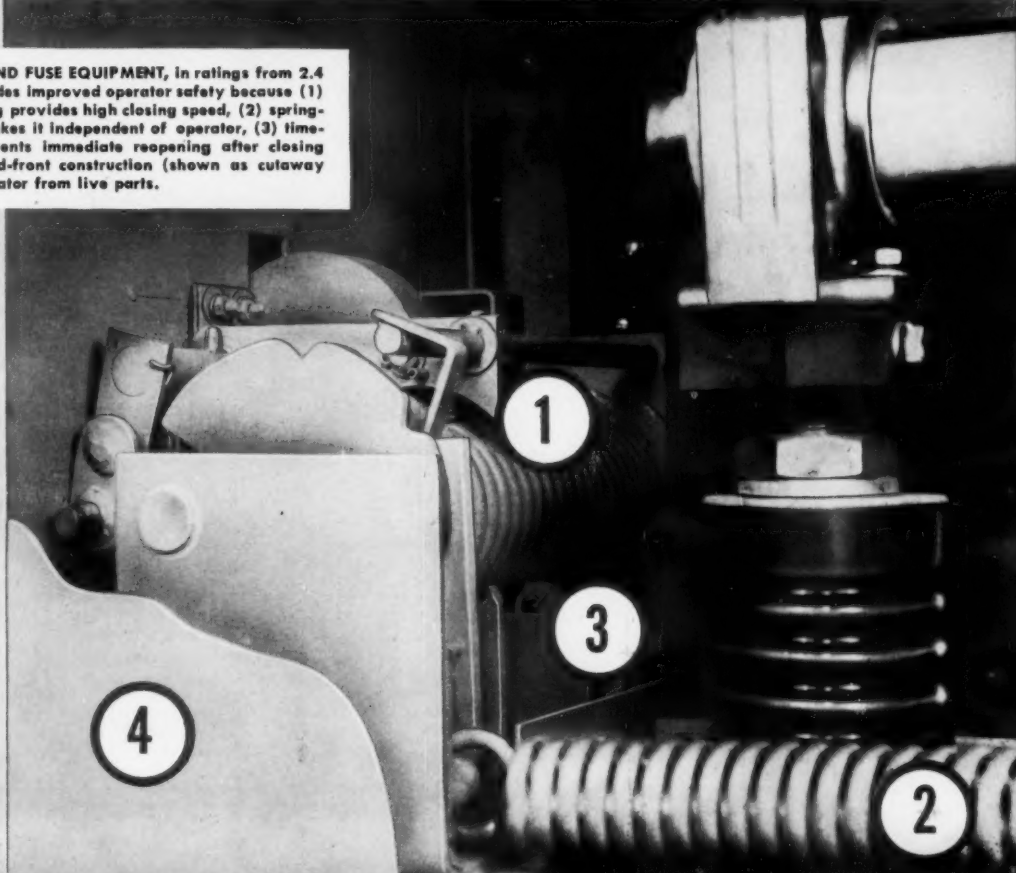
Improved protection, ease of maintenance and inspection, and installation versatility are other benefits you get with this switching and protection equipment. For more information

call your nearest General Electric Apparatus Sales Office or write for Bulletin GEA-6623, General Electric Company, Section B 514-4, Schenectady, New York.

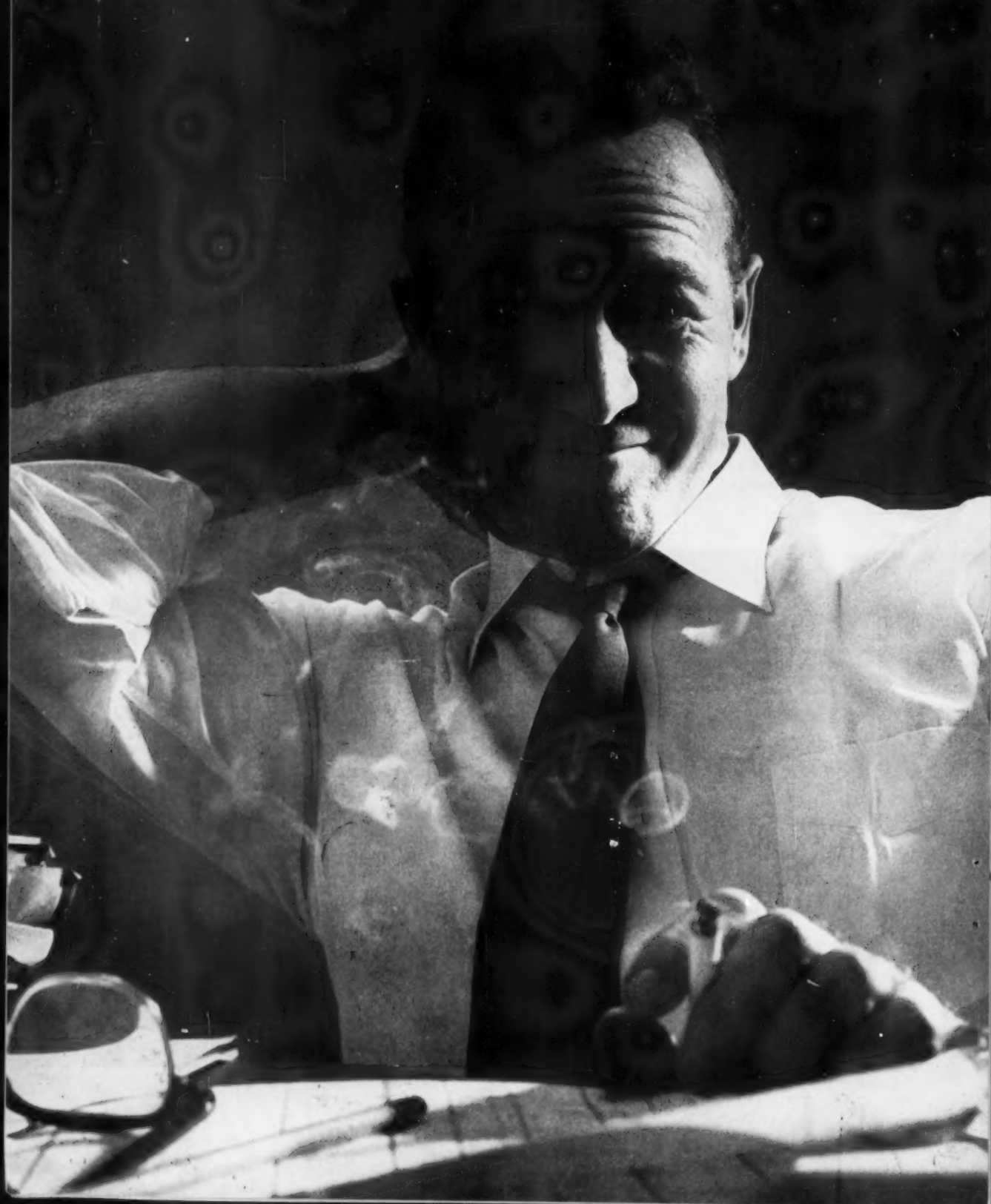
Progress Is Our Most Important Product

GENERAL  ELECTRIC

ROLLOUT SWITCH AND FUSE EQUIPMENT, in ratings from 2.4 kv to 13.8 kv, provides improved operator safety because (1) stored-energy closing provides high closing speed, (2) spring-operated opening makes it independent of operator, (3) time-delay interlock prevents immediate reopening after closing switch, and (4) dead-front construction (shown as cutaway below) protects operator from live parts.



You deserve to



KNOW

you've ordered the best

... and you have a right to be pleased with yourself when you do. Your own reputation rests on the kind of electrical equipment you order and the way you install it. And you can't afford to risk ordering and installing NOISY TRANSFORMERS...but are you?

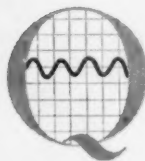


You deserve the satisfaction of *knowing* you're giving your customers the best... the quietest, most efficient, most economical transformers available... *when you make up your list of materials.* And you can get the best *without paying a premium* by ordering and installing General Electric dry-type transformers.

HERE'S WHY: When you order G-E dry-type transformers for replacements or to meet the architect's specifications on a new project, you're not just ordering a necessary control device between the power source and the utilization equipment. Instead, you're ordering **QUIET OPERATION.** General Electric *Quiet* dry-type transformers are designed and built for maximum efficiency and reliable, long-life operation.

Why leave yourself open to transformer NOISE COMPLAINTS? Don't take the chance. Order and install General Electric *Quiet* dry-type transformers for the satisfaction of *knowing* you're getting the best. You'll find there's no "approved equal."

If there's a doubt in your mind, contact your local G-E Distributor or Apparatus Sales Office for more information. Or, send in the coupon below.



Always Order . . .

***Quiet* G-E DRY-TYPE TRANSFORMERS**

GENERAL ELECTRIC

Send for this new bulletin before you order another transformer.



SECTION B411-5, GENERAL ELECTRIC CO.
SPECIALTY TRANSFORMER DEPT.
FORT WAYNE, INDIANA

Please send me the new bulletin "7 Guides for Selecting and Installing *Quiet* Dry-type Transformers," GED-3424, plus the new G-E Dry-type Transformers Buyers Guide, GED-6717, to help me order.

NAME _____ TITLE _____

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Name of your G-E Distributor _____



MR. EDWARD ACKERMAN
THE MANHATTAN SHIRT CO.

*Fusetron dual-element fuses
protected 150 motors against
burnout when a hurricane
single phased our primary line*

MR. EDWARD ACKERMAN
CHIEF ELECTRICIAN-THE MANHATTAN SHIRT CO.
PATERSON, NEW JERSEY

Mr. Ackerman continues . . .

"One afternoon a hurricane struck and single phased the line feeding our plant.

"At the time, all 150 of our sewing machines were in operation. No one suspected the motors were running single phase. Our first warning came when the machines started shutting down through the plant as Fusetron fuses began blowing to protect the motors.

"I had no idea in what condition we would find the motors. It was certainly a relief when we checked and did not find one damaged sewing machine motor. Around 300 Fusetron fuses had blown to protect them.

"You can imagine how costly it would have been to repair or replace these ½ hp., 3 phase, 220 volt motors — and our plant would have been out of business while this work was being done. So we think we paid a very small price when our only expense was replacing the 3-2/10 ampere Fusetron fuses.

"Since this experience, our seven other plants have been informed of the above incident, and it has been suggested to them, that they protect all sewing machine motors with Fusetron dual-element fuses."

Why Fusetron fuses provide safest, simplest way to prevent damage from single phasing.

When single phasing occurs, the current in the remaining phase increases about 100%. (Theoretically 73% but change in efficiency and power factor makes it about 100%.

This 100% overload on Fusetron fuses of motor-running protection size opens them and shuts down the motor.

Such dependable protection against motor burnouts from single phasing has never before been available.

You too, can get maximum electrical protection and save money by installing Fusetron dual-element fuses throughout the plant

With rare exceptions on commercial and industrial installa-

tions — ordinary fuses and circuit breakers protect only against short-circuits — but Fusetron dual-element fuses provide 10 point protection.

FOR LOADS ABOVE 600 AMPS. — USE BUSS HI-CAP FUSES TO COORDINATE YOUR ELECTRICAL CIRCUITS.

On 600 volts or less, BUSS Hi-Cap fuses have interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuits of origin.

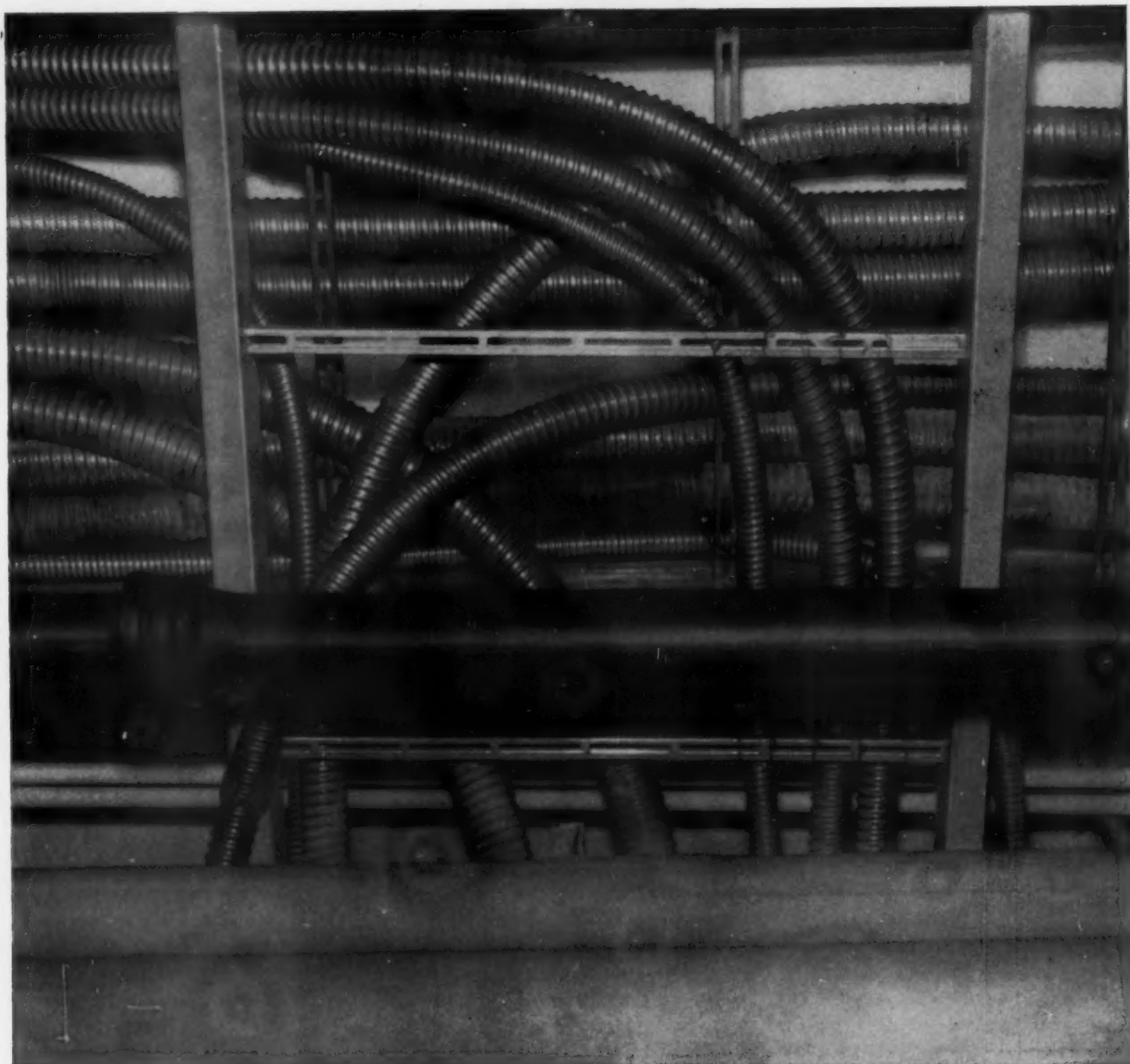
FOR MORE INFORMATION ASK FOR BULLETIN FIS ON FUSETRON DUAL-ELEMENT FUSES — BULLETIN HCS ON BUSS HI-CAP FUSES.

BUSSMANN MFG. DIVISION
McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.



Play Safe! install FUSETRON dual-element FUSES and BUSS Hi-Cap FUSES throughout entire Electrical System!





CREDITS—Owner: SCHLEGEL MANUFACTURING COMPANY, Rochester, New York; Electrical Contractor: T. H. GREEN ELECTRIC COMPANY, Rochester, New York; Builder: JOHN W. RYAN CONSTRUCTION, New York City; Architect: SERGE P. PETROFF, New York City; Structural Engineer: STROBEL AND SALZMAN, New York City; Construction Engineer: GUY B. PINERO, New York City.

Tiger Brand Electrical Wire & Cable



A standard cable for every special job

- Asbestos Wire and Cable
- Mold Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable

You could do this with conduit but think what it would cost!

JUST IMAGINE THE MAN-HOURS that would have been required to bend and contort steel conduit to fit this maze-like 480-volt, 3-phase, 4-wire industrial distribution system. We don't know how much more a conventional installation of cable-in-conduit would cost because Schlegel Manufacturing Company chose the sensible way out: flexible, easily installed USS Tiger Brand Armorlokt Interlocked Armored Cable.

Saves time—We know, from experience on other jobs, that a conduit system would have required about twice as much time to install. It would probably have required larger size cable,



because of the higher voltage drop. It would have required about three times as much material.

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Step-down. Incoming voltage to Schlegel Manufacturing Company's main plant substation is 33,000 volts. This is stepped down to 480/277 volts, 3 phase, 4 wire, and distributed to unit substations like this one, where voltage is stepped down to 240 volts and distributed to plant electrical equipment. 600-volt Armorlokt was used throughout, in sizes #2 AWG, 2/0, 4/0, 350 MCM, and 500 MCM. Most of it was 3-conductor cable. Armor was galvanized steel. Schlegel manufactures beading fabric for doors on Ford and General Motors cars . . . also makes industrial fabric for other applications.

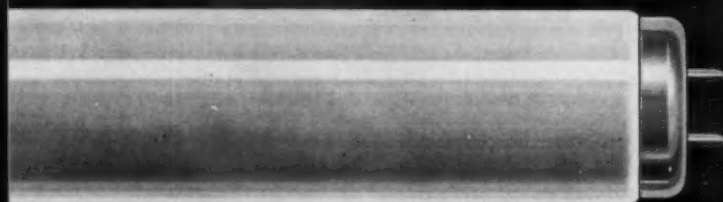
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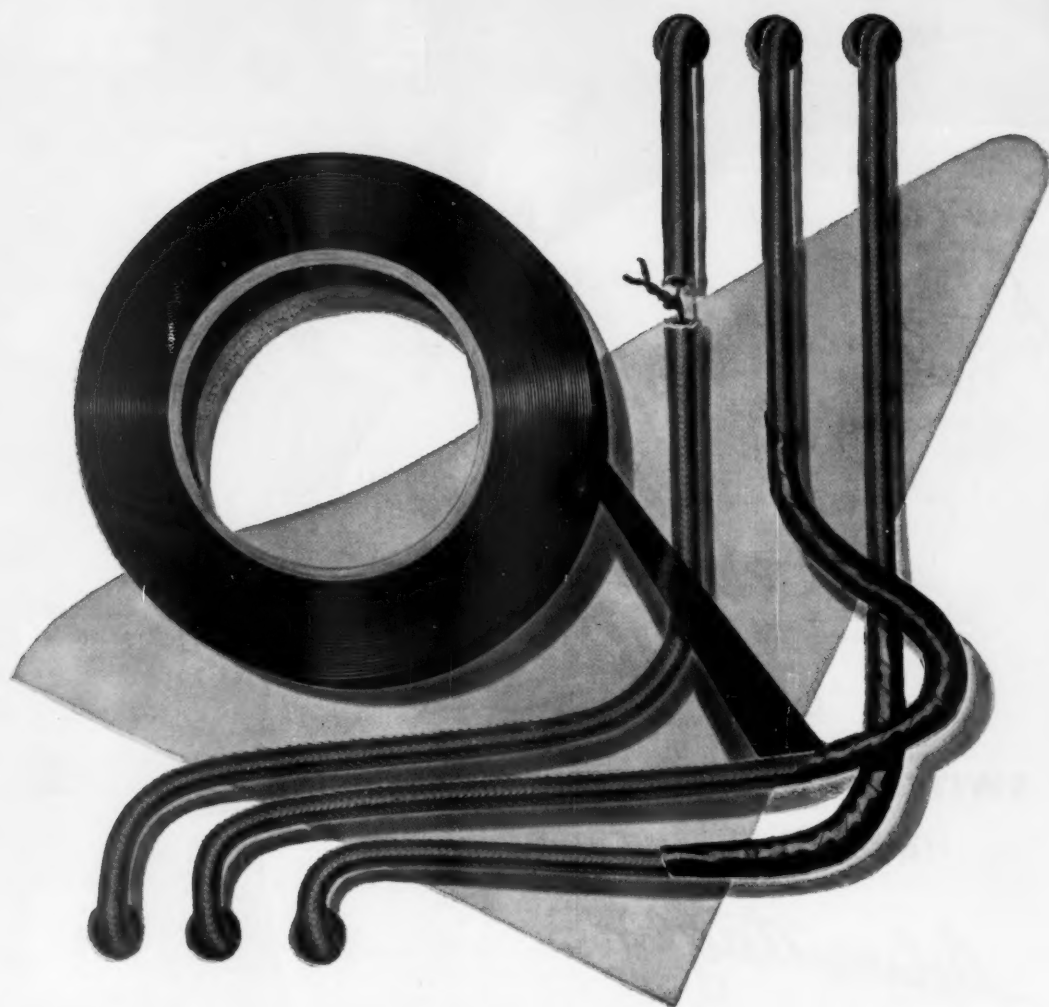
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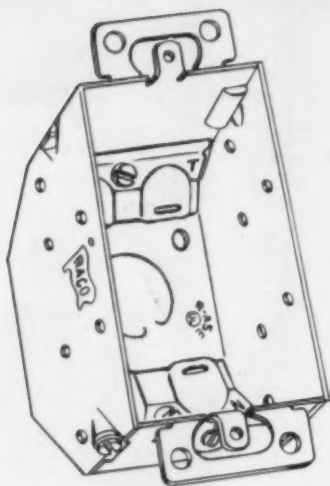


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Murder Clauses

In "Questions on the Code" in the May issue, a correspondent described a transformer installation in which he was required to provide without extra charge a masonry barrier to comply with the Code even though the detailed plans and specifications neither showed nor described such construction. This is the kind of thing that happens all too frequently when the specification is salted with "murder" clauses. A few well chosen phrases in the general conditions can commit the electrical contractor to costly extras at his own expense to cover gross errors or deficiencies in engineering design.

Among the more notorious "murder" clauses are those which require the contractor to guarantee, in addition to materials and workmanship, "satisfactory performance" of the electrical system. This seemingly routine condition of the contract actually commits the contractor to underwriting the engineering design at his own expense. Few, if any electrical contractors, in the short time provided for bidding, can thoroughly check engineering details of the job.

Even the conventional "compliance with all codes, ordinances and standards" can become a "murder" clause if the detailed plans and specification furnished fail to comply. A NECA Chapter in California is currently working toward amending clauses which state that the electrical work be installed in accordance with the National Electrical Code and other ordinances to include the phrase "except for design".

On conventional engineered construction, the responsibility for producing plans and specifications that will provide "satisfactory performance" and that are accurate, complete and in accordance as to design with applicable codes, standards and ordinance, belongs to the architect and engineer. If it is intended that this responsibility is to be undertaken by the contractor, he should be clearly warned of the warranty he is expected to assume and instructed to make a thorough engineering and code-compliance study of the plans and specifications prior to bidding the job.

Catch-all clauses do not necessarily stand up when the plans and specifications detail the work and their instructions have been carried out in letter and intent. When they are invoked to hook the contractor for errors and omissions in design, they can often be fought successfully. But such disputes can run into long delays and great expense.

The time to attack the "murder" clause is before the bid is filed. If protests don't bring prompt and reasonable amendments, the only alternative is to appraise the potential risk and include a prudent sum in the price to cover any contingency. As for those tricky specs which permit payments to be held up for trivial, capricious or arbitrary reasons, it is best not to bid on them at all.

Wm. T. Stuart

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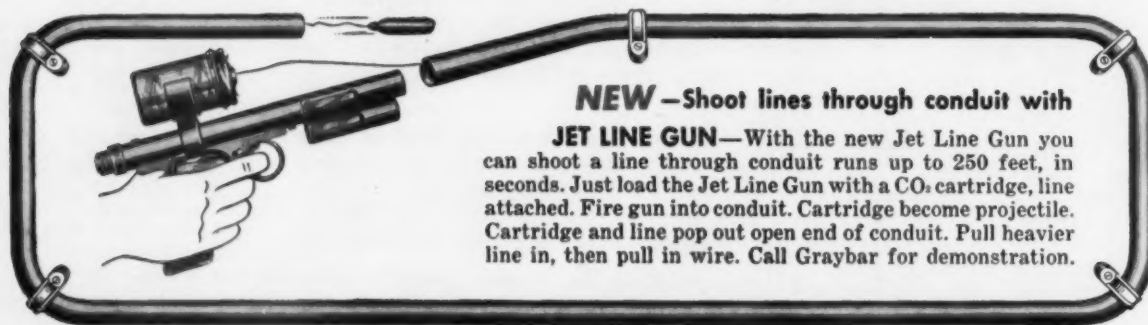
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*Experience gained in cyclotron laboratory
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Electrical and Electronic Maintenance

Control system and maintenance program developed at University of California Radiation Laboratory offer foolproof remote control for operation and protection of costly equipment; also serve as guide in promptly locating trouble by audible and visual alarms.

By C. William Jensen

Electronics Engineering, Maintenance Coordinator, University of California Radiation Laboratory, Livermore, Calif.

Due to the impact that atomic physics is destined to have upon the future of our industry, we believe that this discussion is pertinent and timely. It is likewise authoritative and factual, inasmuch as it comes from "the birthplace of the cyclotron" and was prepared on assignment under the auspices of the U. S. Atomic Energy Commission. For purposes of reader orientation, the author introduces this informative discussion with a brief history of the development of cyclotrons in general and of the U. of C. 90-in. cyclotron at Livermore in particular.

ADVANCES in knowledge of the atomic nucleus have resulted largely from the physicists' technique of firing high-energy atomic particles at "target" atoms and studying what takes place.

Prior to 1932 the tool that physicists used to accelerate these atomic particles was a "linear" accelerator. This was a long vacuum tank containing a series of cylinders spaced in a straight line. As each cylinder was connected to high voltage of correct phase, the atomic particles were given an extra "kick" each time they passed through one cylinder and into the next. The particles were thus raised to high-energy levels by the time they reached the end of the accelerator.

To obtain the high energies required by the physicists, this linear type of accelerator would have had to be of great length, with voltages impractically high.

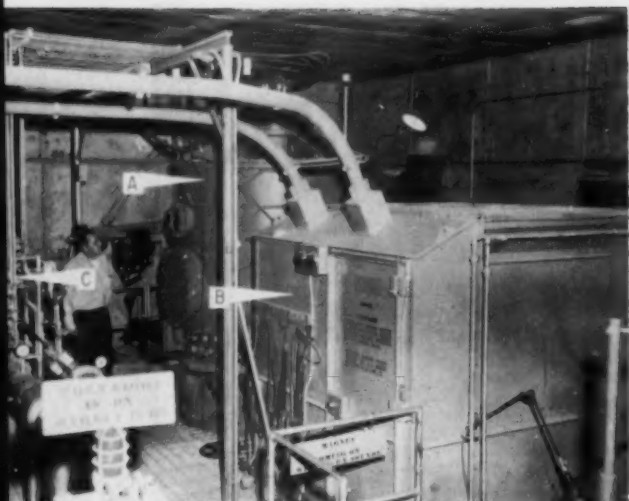
It was then that the University of California's Professor E. O. Lawrence invented the cyclotron,

an accelerator that opened a new era in the study of atomic physics.

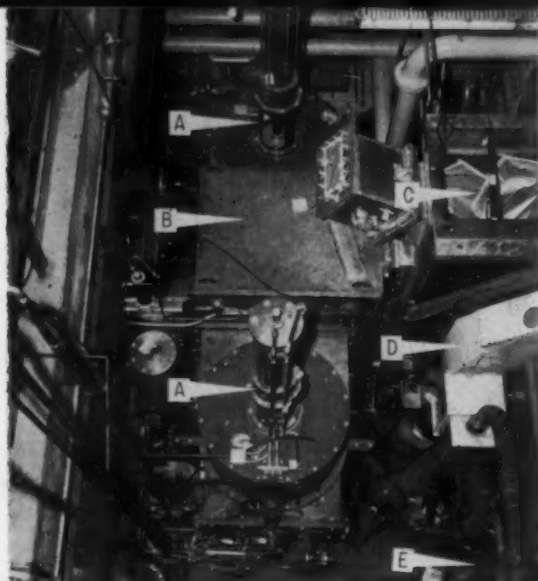
In this device the atomic particles were accelerated within a rather flat vacuum tank placed between the poles of a strong electromagnet. The particles were "whipped" around and around in ever widening spirals, being given a push, or energy boost, each time around. During the first experiments these particles were accelerated to energies above 1,000,000 electron-volts, even though the magnet poles were only 11 in. in diameter and accelerating voltage a moderate 4000 volts.

This machine made it practical to accelerate atomic particles to much higher energy levels, and thus it provided the physicists with an immensely more powerful tool for exploring the atomic nucleus.

Both the Nobel Prize Committee and the Atomic Energy Commission have attested to the importance of this advance to the scientific world by making awards to Professor



1—INSIDE CONCRETE BLOCK SHIELDING, which is 5ft in thickness, Maintenance Supervisor H. R. Buddingh stands on upper level to view 90-in. Cyclotron dee-stem cavity (A) and 140-kv deflector bushing inclosure (B). Banks of interlocked flow switches (C) assure sufficient cooling water to radio-frequency cavity liner, dee stem, and shorting planes, before RF power may be turned out. Cyclotron magnet and vacuum tank are on level below. See Fig. 2.



1A—CYCLOTRON LOWER FLOOR LEVEL, pictured during construction, shows complexity of equipment. The two cylinders (A) above and below center are remote-control gate valves that close automatically with a loss of vacuum. Rectangular plate (B) is top of vacuum manifold. Into vacuum tank opening to right (C) will be suspended the dee (hollow plate that accelerates atomic particles). Light-colored housing (D) covers electromagnet coils. Magnet yoke is at lower right (E).

E. O. Lawrence for his invention.

So successful were his early experiments that other cyclotrons were constructed by the University of California. They were the 37-in., 60-in., giant 184-in. and the 90-in. machines; the last-named, about which this article is written, being located at the Livermore site.

These machines have control systems that are elaborate networks of electrical and electronic equip-

ment. These networks open whole new areas of maintenance problems, which can be solved by methods pointed out in this article.

The 90-in. Cyclotron at the Livermore site of the University of California Radiation Laboratory is used for basic research in studying the fundamental reactions among nuclei. Since these studies cover a broad range of problems in nuclear physics, it is necessary to tune a

beam of either protons, deuterons, or tritons, over wide ranges of energies. Thus, protons may be tuned through energy ranges from 4 to 15 million electron volts (Mev), deuterons from 4 to 12.5 Mev and tritons from 7.5 to 8.5 Mev. To accomplish this, the radio-frequency system is tunable from 4 to 9.5 megacycles. The magnetic field is adjustable from 2000 to 9000 gauss. These features make this cyclotron one of the most versatile in the world.

This is the first cyclotron actually designed and built as a variable-energy machine. It is one of three such machines in existence today, all of which are in the United States. Following the design of the model magnet in October 1952, major construction began in the summer of 1953, and the cyclotron was completed in February 1955 at a cost of approximately \$1,000,000. The first beam was produced on February 18, 1955.

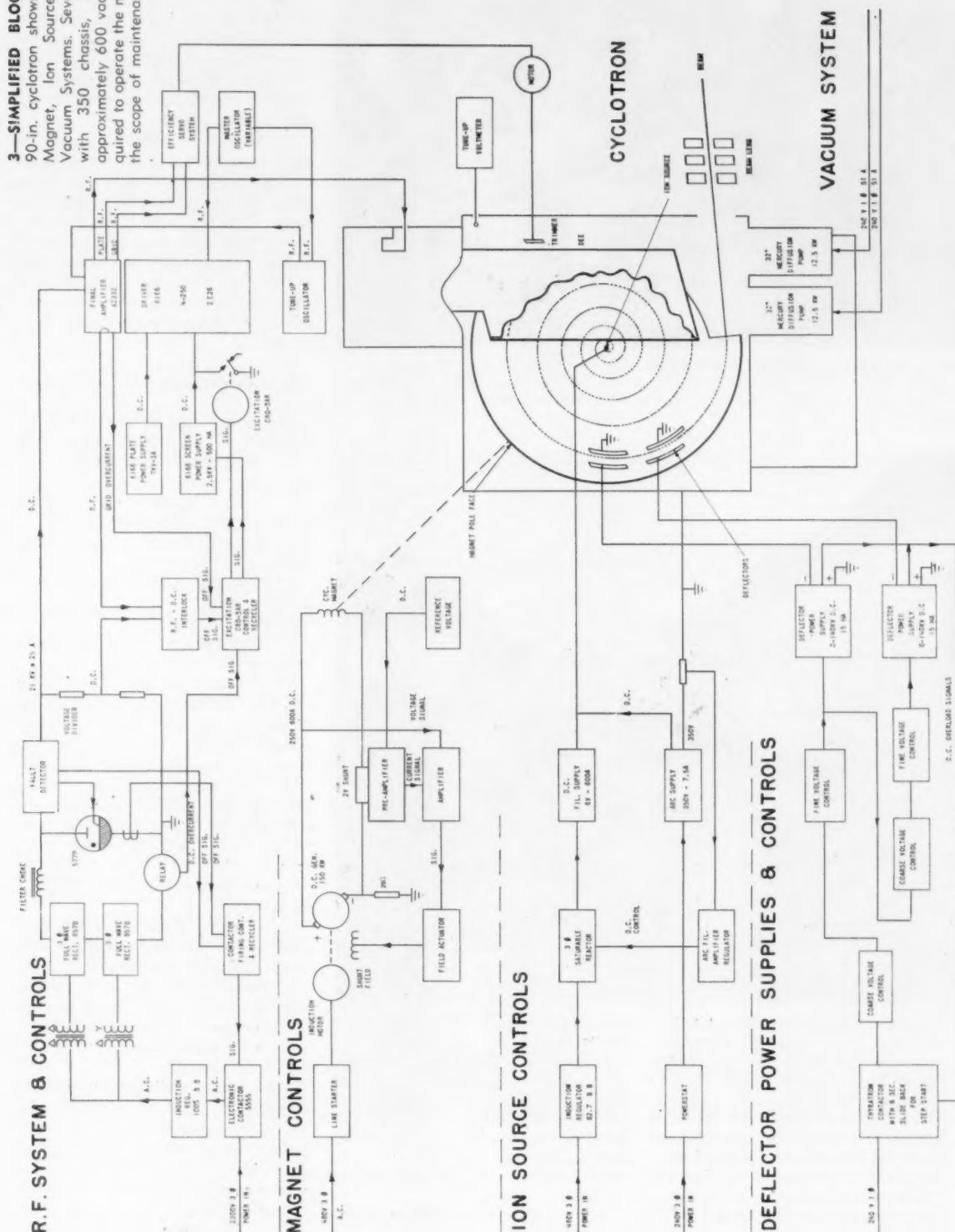
Besides being versatile, the 90-in.-cyclotron is also unique. While many cyclotrons use the conventional "O"-shaped magnet with horizontal pole faces, the Livermore machine is constructed around a "C"-shaped magnet with vertical pole faces. This may be seen in Fig. 2.

While the foregoing has pointed out differences between this and



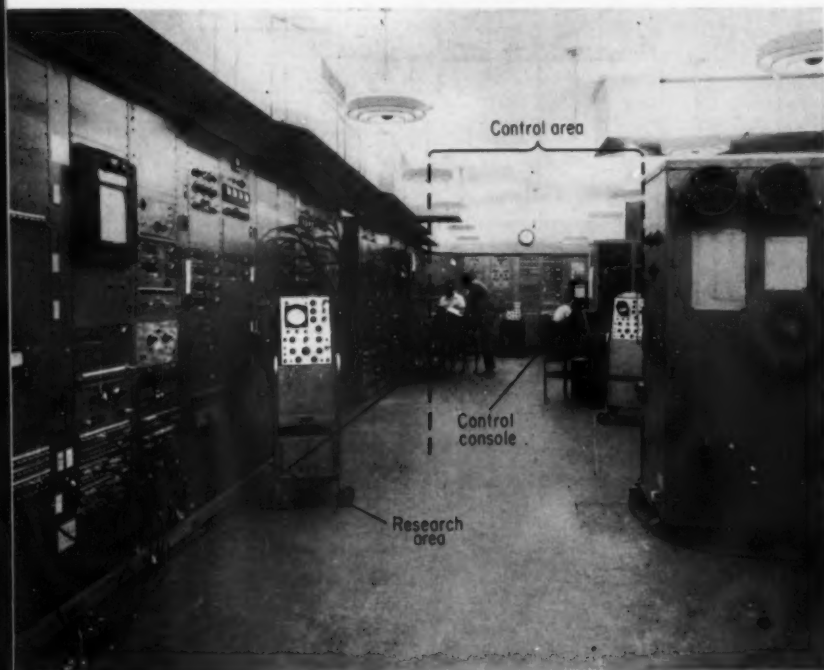
2—90-IN. CYCLOTRON, during construction, shows magnet vertical pole (A) at left, inside vacuum tank. Electromagnet coil windings are housed under light-colored plates (B) to left and right of vacuum tank (C).

3—SIMPLIFIED BLOCK DIAGRAM of 990-in. cyclotron shows Radio-frequency, Magnet, Ion Source, Deflector and Vacuum Systems. Seventy control racks with 350 chassis, 225 relays, and approximately 600 vacuum tubes are required to operate the machine and depict the scope of maintenance work.





4—CYCLOTRON CONTROL CONSOLE shows many of the standard "building block" panels. Safety-chain interlock indicator lamps may be seen above oscilloscope. Trouble alarms (X-panels) are visible to far right. Both aid maintenance in pinpointing failures.



4A—CONTROL AND RESEARCH AREA depicts racks to the left, showing equipment used by physicists in the collection of experimental data. For this work maintenance men service an additional 375 chassis, using 2000 vacuum tubes. Cyclotron control console is at end of room. See Fig. 4.

other cyclotrons, there are five basic categories common to all cyclotrons, under which may be classified most electrical and electronic equipment. These categories are: (1) RF System, (2) Magnet, (3) Ion Source, (4) High Voltage Deflector, and

(5) Vacuum System. Most of the controls are remote from this equipment. They are interlocked to provide safety to personnel and the equipment itself.

The simplified block diagram (Fig. 3) shows the grouping of

this equipment and how it connects to the cyclotron proper. To provide required versatility, more electronic and electrical controls are necessary than for a conventional fixed-frequency cyclotron. To give some idea of the scope of maintenance work, the electronic-electrical control circuits of the cyclotron at present are comprised of 70 control racks, housing 350 chassis, 225 control relays and approximately 600 vacuum tubes.

In addition to this, it is necessary to service 375 pieces of associated equipment used by the physicists in the research area (Fig. 4A). This equipment is mounted in 30 racks and uses 2,000 vacuum tubes. To obtain maximum reliability of operation for all this electrical and electronic equipment, a planned maintenance program is required.

Keys to Effective Maintenance

There are five keys which have resulted in an effective maintenance program for the 90-in. cyclotron. These are:

1. Control system and chassis design speeds trouble-shooting.
2. A preventive maintenance program.
3. Planning and scheduling maintenance work.
4. Personnel training.
5. Replacement parts available when breakdowns occur.

If you are presently designing an electrical control system it would be well to consider the layout, component, and terminal designations from the maintenance viewpoint.

All too often little thought is given to this subject, with the result that customer satisfaction is wiped away the first time their maintenance man has been called to service commercially manufactured equipment.

How many times have we seen control circuits that perform well their designed function, but have components installed in racks, or control cabinets, in such a haphazard manner as to defy identification, even with the aid of a control circuit diagram?

Also, circuit diagrams showing components with no identification, relays whose contacts are on other prints (but *which* print?), and lines identifying wires which end at the edge of a diagram to connect to we know not where—these are the maintenance man's dilemma,

which the laboratory control design system succeeds in eliminating.

In explaining how the control circuit design aids the maintenance man in trouble shooting, it is important to understand first what the control system consists of, how it is interconnected, how the numbering system identifies equipment, and how control-circuit diagrams identify components and terminals.

Control Racks and Panels

Basically, the remote control system consists of (1) standard racks and panels, or "building blocks," and (2) a logical numbering for panels, components, and terminals. The control room photograph (Fig. 4) shows a grouping of standard racks. These racks, which may be either single or double, are 84 ins. in height.

The single rack is 27 ins. wide and provides for a single row of standard panels 19 ins. wide, plus a wiring gutter, which may be constructed to either right or left.

The double rack is 46 ins. wide and provides for two vertical rows of standard 19-in. panels, with a wiring gutter in the middle. Fig. 5 gives a rear view of one of these racks. The panel mounting angle irons are drilled from top to bottom every 1-3/4-in., for the purpose of mounting control panels and electronic chassis. This 1-3/4-in. spacing between panel mounting holes is significant to the panel numbering system and will be explained below.

Certain panels that are used in every installation are referred to as "standard panels". These are the "building blocks" around which the control circuits are designed. On these panels are mounted like components. As an example there are standard panels of relays, push-buttons, trouble alarm indicators, HV key interlocks and safety-chain lamps. For convenience these panels are lettered, respectively: L panel, C2 panel, X panel, AW panel and M panel. Some of these panels may be identified in the control room photograph (Fig. 4). A pushbutton panel (C2 panel) may be seen on the slanting console directly between the oscilloscope and the oscilloscope operator. Trouble alarm indicator panels (X panels) are visible to the far right of the photograph, while HV key interlock panels (AW panels) are to

the left of the console operator. Components on some of these standard panels may be seen in Figs. 5 and 6.

Another type of standard rack is known as the "cross-connect" rack. A view of this may be seen in Fig. 7. Laboratory standards provide for this cross-connect rack to be either single or double type. The 90-in. cyclotron control circuits require two of these double racks, each providing 60 Western Electric No. 101B terminal blocks. As each block provides 80 tie points, there are a total of 9600 connection points available.

In the cross-connect rack lies the heart of the control system design. The rack provides for design flexibility, and is the trouble-shooting area for many a maintenance problem.

Fig. 8 is a block diagram that shows how the cross-connect rack is utilized in conjunction with various standard panels. The terminals on each of the standard panels are cabled directly to a predetermined cross-connect block. To interconnect components on the various standard panels, it is only necessary to run a jumper wire from one selected terminal to another. The manner in which these cross-connects are made is determined by the control circuit designer.

All standard racks and panels are stocked in Laboratory ware-

houses. On rush jobs these various "building blocks" may be mounted in racks at the same time the control circuits are being designed. By the time construction is completed the control circuits have been designed and the necessary cross-connects may then be made. This is a considerable saving of time.

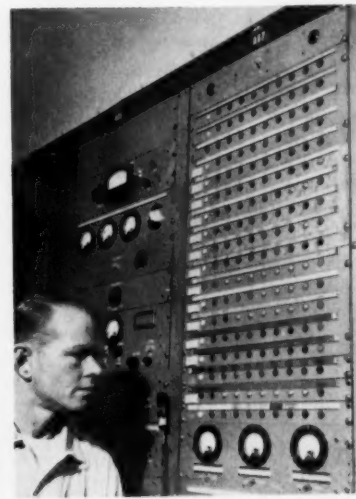
Numbering System

Where so much equipment is involved it would be almost impossible for maintenance men to find racks, panels, and components without adequate equipment identification. Unlike numbering systems that identify individual wires by number on schematics, the system herein described provides for easy identification of any panel, component, or terminal. To understand this numbering system let us return briefly to the previous discussion of standard racks.

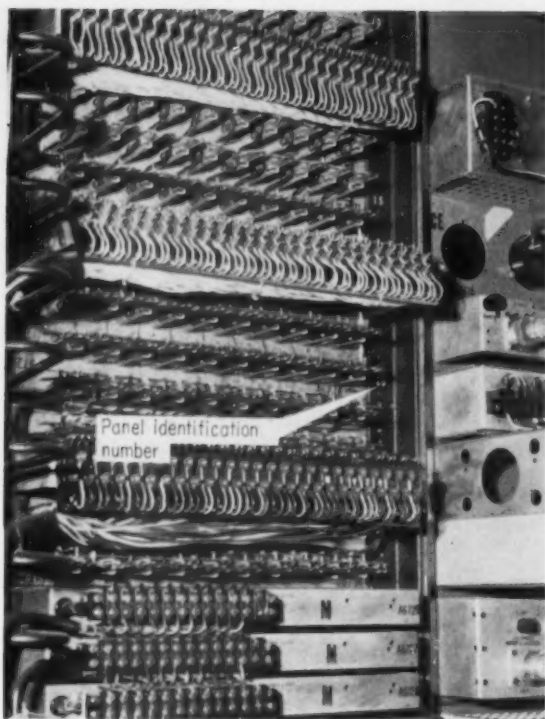
It was mentioned that panel mounting angle irons were drilled and tapped for panel mounting screws at distances of 1-3/4-in. Each of these 1-3/4-in. spaces is assigned a number, beginning at the top of the rack with No. 9. Numbers progress from the top to a point 17-1/2 ins. above the bottom of the rack, using numbers 9 through 46. The identifying numbers of these spaces on rack A67 may be seen in Fig. 6. Stenciled



5—REAR VIEW OF DOUBLE RACKS shows how cable is brought through the center wiring gutter. A maintenance man points to severely burned contacts in standard relay panel. Rather than replace relay, wires were quickly switched in racks to connect spare relay.



5A—180 SAFETY CHAIN INTERLOCK LAMPS located in control rack A67, indicate operation of safety devices installed for protection of equipment and personnel. By noting which lamps are out, maintenance men are often guided directly to source of trouble.



6—REAR VIEW OF RACK 67. Vertical angle iron to right shows panel mounting screw holes every 1 3/4-in. Each of these spaces is assigned a number which identifies the panel mounted in that space.



7—CROSS-CONNECT RACK is heart of control-system design. Much trouble shooting is accomplished here. A maintenance man switches cross-connect wiring to spare relay terminals instead of changing damaged relay. See Fig. 5.

numbers of 10, 15, 20 and 25 appear on the vertical panel mounting angle to the right. A 1-3/4-in. panel mounted opposite the space designated as No. 28, would therefore take on that number of 28.

Let us consider an identifying number of A6728M2. The first letter, A, indicates the area in which the rack may be located. Areas outside the control room might be designated as "B", "C", "D", etc. The first numbers, 67, indicate the control rack. The following two numbers, 28, show the vertical position at which the panel is located. M refers to the particular standard panel. The 2 indicates that this is the second lamp from the left, as viewed from the rear of the rack. In a like manner the number A6728-03 indicates terminal No. 3 on the same panel.

No numbers are assigned to the lower 17-1/2 ins. as this panel space is reserved for the eight terminal blocks, which receive the incoming and outgoing rack wiring. Terminal blocks at the bottom of any rack are assigned numbers 01 through 08. However, four terminal blocks are often enough. In

this case the blocks are numbered 05 through 08. Such a terminal number in the bottom of rack A107, may have the number A10705-12. This may be seen in Fig. 9. Referring now to the numbering of the cross-connect rack, the number CX26-23 can be explained as follows: Letter C indicates the area in which the cross-connect rack is located. The letter X denotes the cross-connect rack. No. 26 indicates that it is the 26th block, while the -23 indicates the terminal. This block may be seen in Fig. 7, as the fifth block from the bottom in the 3rd row from the left.

Control Circuit Diagrams

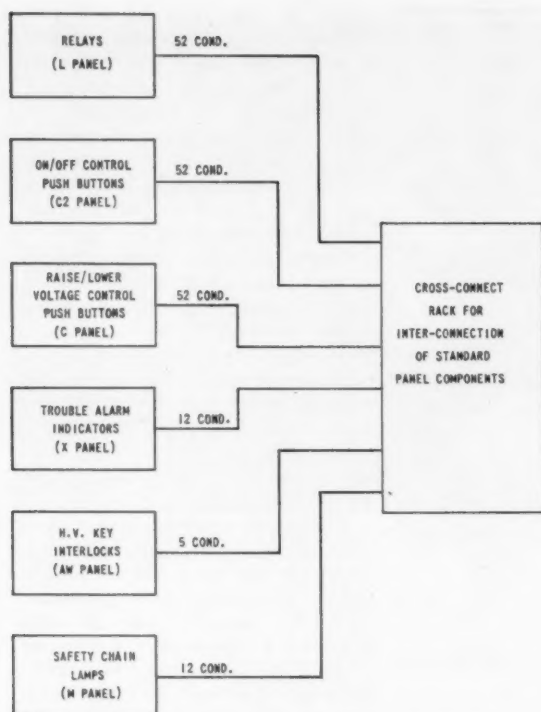
Fig. 10 is a portion of the control circuit diagram for the 500-kw rectifier interlock chain. By noting the lamp numbered A6728M2 circled in the figure, it is easy to see how the control diagram identifies each area, rack, panel space, panel type, component and terminal. This numbering system is easily learned. With little practice it is possible to glance at a control circuit diagram, note a particular number opposite one of the component symbols, and

then go directly to the specific component in the control rack.

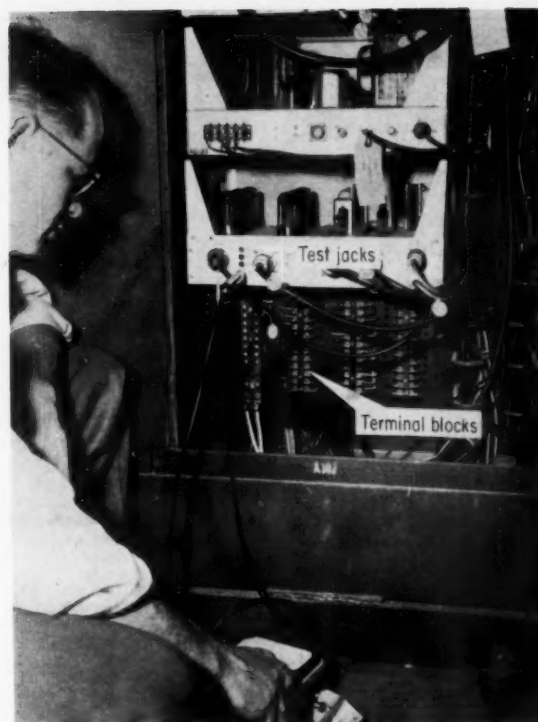
On complicated remote control diagrams, relay coils often appear on one diagram, while their contacts appear on another. To guide the maintenance man to the correct diagram, the diagram number is written beside the coil symbol. Such references to relay contacts and diagram numbers may be seen beside the coil A11-22-L3.

However, even after locating the correct diagram it is often difficult to locate certain relay contacts among a variety of other symbols, particularly when a control circuit diagram may be 12 ft. long and 4 ft. wide. Therefore, as a further guide to the maintenance man, the diagrams are divided into sections, much the same as a city street map. Numbers appear at intervals across the top and bottom of the diagram, while letters appear at intervals along the left and right edges. These may be seen in Fig. 10. Accordingly, the designation G4 beside relay A11022-L3 (see arrow) would allow the maintenance man to quickly locate the relay contact on diagram LE 1514.

These control circuits not only



8—STANDARD "BUILDING BLOCK" PANELS are terminated at common wiring area; the cross-connect racks. Here various standard panel components may be easily connected in any desired combination.



9—BOTTOM OF RACK A107 shows terminal blocks where incoming and outgoing rack wiring is connected. Chassis are provided with voltage monitoring test jacks where routine checks may be made on power supply voltages.

provide automatic sequence of operation in which one function is interlocked with another, but they also serve to protect expensive components from damage. Likewise, they provide alarm indication when a particular piece of equipment is not functioning properly. In the latter cases then, the system itself is an aid to maintenance. By means of the audible alarm provided by the X-panels and the extinguishing of safety chain interlocking lamps, maintenance personnel may be led directly to a source of trouble.

As an example, if beam cylinder cooling water were interrupted momentarily on the A2332 final amplifier tube, the filament power would continue to stay on, assuming there were no interlock. Considerable damage to the tube would result, making it necessary to rebuild the tube, or possibly replace it at a cost of \$12,000.

Next, if beam-cylinder cooling water were interlocked to shut off the A2332 plate voltage and filament power, but there were no visible indication, it would be a complicated maintenance problem to locate the failure. However, if such a failure were to occur (and

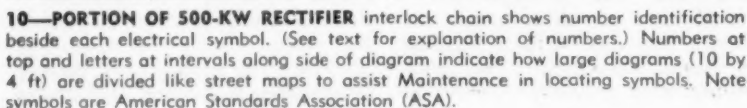
it has) there would be an audible alarm provided by the X-panel. The safety-chain, beam-cylinder-water indicating lamp, as well as all other lamps after it in the safety chain, would go out. Also, plate voltage and filament power to the tube would be turned off automatically. By quick reference to the safety-chain lamp in rack A67, maintenance personnel would go directly to the source of trouble. Correcting such faults as this are part of daily activities for the maintenance man. This visible trouble-shooting saves hours of trouble-shooting time and is one reason for high "on-time" of the cyclotron.

Consider a second example, where the operator is unable to turn on the high voltage rectifier, which feeds plate voltage to the A2332 final amplifier tube. A glance at the safety-chain interlock lamps would tell the maintenance man that the rectifier filament time-delay had failed, if that particular lamp and others after it were out. He would have a clue to where the trouble was and begin to pinpoint it within that circuit. The cross-connect rack provides an excellent

area to make tests and further pinpoint the source of trouble. Naturally, not each component or relay contact will have an indicator light in the control-room safety-interlock chain. However, all component contacts and terminals are available, so to speak, at the cross-connect terminal blocks. The maintenance man, using the control circuit diagram as a guide, and the aid of a 115-volt lamp, can quickly check for power at various terminals and locate which component has failed to operate.

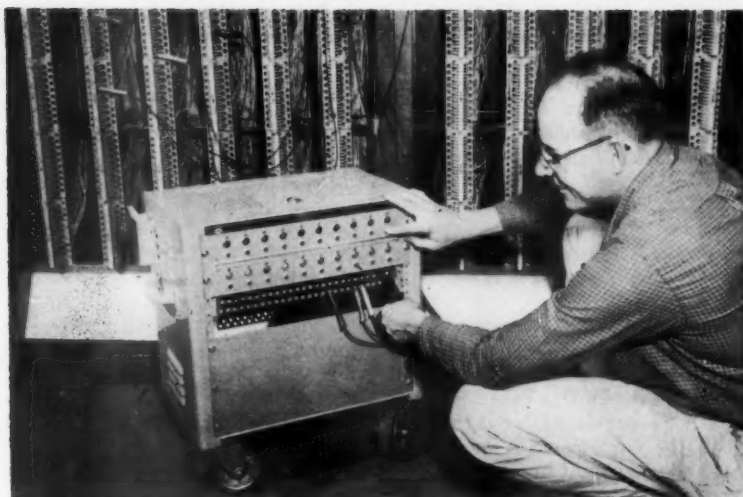
Aside from the manner in which the control system leads maintenance men to a source of trouble in equipment which the control system itself creates. Some following examples will tell of our approach to these control-circuit maintenance problems.

In Fig. 5, a maintenance man points to a relay with severely burned contacts. As this failure occurred during cyclotron operations, it was impractical to replace the relay, due to the down-time involved. The answer to correcting this problem was found in the flexi-

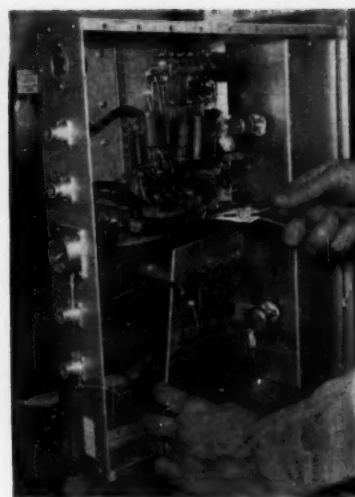


Briefly, the test circuit consists of a number of relays and control pushbuttons. Each relay coil is connected to a monitoring point suspected of being intermittent. Current from the monitoring point initially passes through the pushbutton to energize the relay, which is then sealed in by the current passing through its own contacts. If the monitored voltage is intermittent, the indicator relay will drop out, which turns out the red light. This device has led to the solving of many intermittent control-circuit problems.

As the cyclotron control system is made of "building blocks," so the typical electronic chassis is made up of sections, or building-block plates. A typical chassis may be



11—INTERMITTENT CONTROL-CIRCUIT ANALYZER is easily moved to cross-connect rack trouble-shooting area.



12—"BUILDING BLOCK" CHASSIS design allows maintenance men to quickly repair equipment by removing faulty sub-assembly and replacing another.

seen in Fig. 12. Power supplies, voltage regulators and convenient portions of other circuits are mounted on individual plates. This type of construction is particularly desirable from a maintenance viewpoint. If there is malfunctioning of a particular circuit, an entire plate may be removed and replaced with a functioning unit.

Important also, is the fact that in a research organization, chassis have a habit of "growing". As additional equipment becomes necessary, it may be built on one of these plates and later added to the chassis.

Chassis are provided with handles on each side of the front panel, to facilitate easy installation, or removal from control racks.

Preventive Maintenance

Preventive maintenance is the second key to an effective maintenance program.

Before any adequate planning and scheduling of maintenance work may be done, experience has proved that it is necessary to set up records to show what has been maintained and to forecast what should be inspected and maintained to prevent possible breakdown.

In choosing our type of records, several commercially available record systems were investigated to see if they met our needs; also, the problem was taken up directly with the men who had to service the equipment. Valuable ideas and

suggestions were offered, many of which were included in the system that was finally established. Through this type of approach to the problem, the maintenance men helped us to establish goals that we wanted to achieve.

First, we wished to establish a prescribed test setup for maintenance men to follow on pieces of equipment. This meant furnishing a diagram to show connection of test equipment and listing results to be expected.

Only in this way did we feel that consistency could be achieved in restoring the equipment to designed specifications. Second, in order to add interest to their job we wished to furnish the maintenance men with readily available information on the theory of equipment operation.

Third, the men who work on equipment would offer ideas for improved maintenance procedures. We wished to have a file where records of these changes could be kept and made available to the next person.

Fourth, we needed a file which would flag preventive maintenance due dates.

The requirements that we placed on the Preventive Maintenance system ruled out any simple card, which could be checked off following a maintenance procedure. We decided therefore on a jacket folder, 9½ by 12 ins., which would meet the requirements outlined above. Fig. 13 shows one drawer of the

Preventive Maintenance file in which folders are filed.

Fig. 14 shows a Preventive Maintenance folder for a servo amplifier, as well as typical information that the folder contains.

Across the top of the manila folder are printed the months of the year. A metal tab is affixed to the top of the folder. This indicates the next month that preventive maintenance is due. Also, across the top edge of the folder is indicated the type of equipment, manufacturer, schematic number, model number, identification number, and the location of the equipment.

Refer to the left sheet in Fig. 14. There are column headings of "loose solder joints," "rosin joints," "dirty connections," "broken parts," etc. These are faults common to all electronic equipment. Additional columns are provided for adding headings that will call for inspections pertinent to that particular equipment.

A list of necessary test equipment, as well as a block diagram of the test to be performed, is shown at the bottom of this sheet.

Typewritten pages in the middle of the figure are known as Description and Instruction sheets. These are provided by the Engineering Group; they outline the general function and characteristics of the equipment, give the physical description, present the theory of operation, and outline instructions for operation and maintenance.

To the upper right are shown notes and a sketch. These are typical types of information offered by maintenance personnel. This information is first filed and later typed on the maintenance instructions.

During the check-out procedure the maintenance man performs the outlined inspections and checks the appropriate squares. He is guided in the test procedure by the test block diagram, the instructions for operation and maintenance and notes of trouble-shooting experiences filed by others. When he completes his work, he affixes the metal tab to the month when preventive maintenance is again due.

In the lower right-hand corner of the figure can be seen two trouble cards. When a breakdown occurs between the scheduled preventive maintenance dates, a card of this type may be filled out by a maintenance man, or an operator who observes malfunctioning of equipment. They identify the piece of equipment and, if known, the component that has failed. Following repair, the maintenance man writes in a very brief report of the cause of trouble. At the end of every month these trouble cards are reviewed by the maintenance supervisor, prior to having them filed in the appropriate preventive

maintenance folder. When a folder is removed from the file at the time for preventive maintenance, the number of trouble cards is noted. This is the key to how many times the equipment has failed between preventive maintenance inspections. Accordingly, if too many failures have occurred, the preventive maintenance interval is shortened. However, if no failures have occurred, the cycle is extended one month.

Initially used to record equipment failures, trouble cards now are used also in assigning maintenance work. In this case the maintenance supervisor fills out the card, lists the equipment to be worked on, and presents it to a maintenance man. Such an assignment might be for a preventive maintenance check, or the repair of equipment following a failure.

The third key to an effective maintenance program is correct scheduling of maintenance work.

The 90-in. cyclotron is currently operating on a schedule that allows for one eight-hour period of maintenance per month. During this time the cyclotron is shut down completely, so that mechanical as well as electrical and electronic work may be accomplished. In this way a maximum utilization of the down time may be realized.

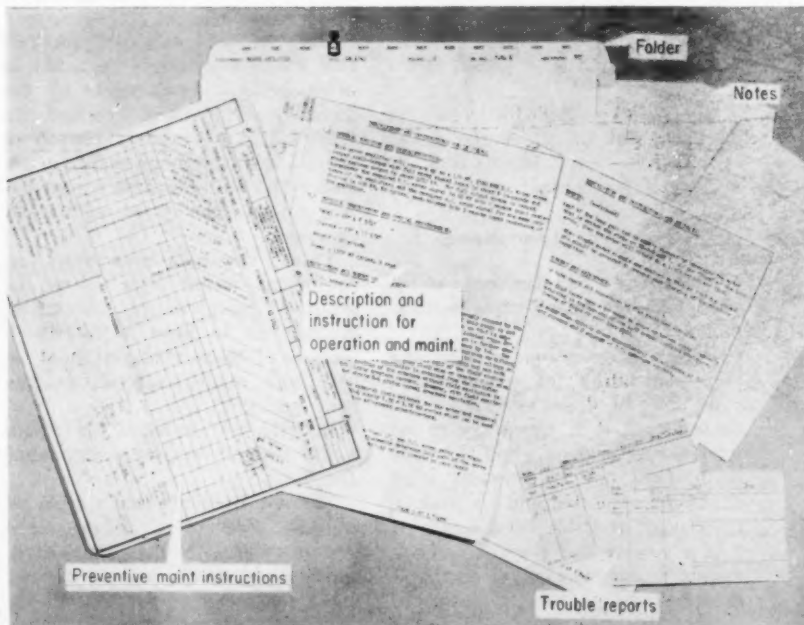
Prior to the shut-down day, the maintenance supervisor notes the Preventive Maintenance folders having tabs that indicate preventive maintenance is due. He confers with the engineers and cyclotron operators to make sure that no equipment requiring maintenance is overlooked. (Figs. 15 and 16 show typical maintenance inspection work being performed to determine the extent of scheduled maintenance required on the next cyclotron "down day".) He then gives a list of maintenance jobs to be performed to the cyclotron coordinator, who compiles a master chart showing all jobs that are to be performed on the coming "down" day. Fig. 17 shows typical maintenance work being accomplished on a cyclotron "down day".

The effect of planning and scheduling may be seen in the graph showing cyclotron "on time", Fig. 18.

During the summer months of 1957, Engineering, Coordination, Operations, and Maintenance groups met to discuss ways of improving the reliability of the machine. Records were reviewed to determine which equipment failed most often. Maintenance effort, as well as that of other groups, was intensified. Maintenance personnel studied rf and servo systems, made



13—MAINTENANCE FILES contain folders identifying each piece of equipment. Tabs note when inspection is due.



14—A PREVENTIVE MAINTENANCE FOLDER for a Servo Amplifier and the information it contains: such as preventive maintenance instructions, description and instruction sheets on operation and maintenance, trouble cards, notes and sketches.



15—150-KW DC GENERATOR (which supplies current to cyclotron electromagnet) is run without field excitation, prior to shutdown day, to determine extent of maintenance to be scheduled. Here brushes are inspected for adequate length, proper seating and freedom of movement within holders.



16—OIL SAMPLE IS TESTED for dielectric strength following its removal from 2500-kva 12,000-to-2400/480-volt power transformer (visible at rear). Tests are made quarterly. If samples do not meet minimum voltage breakdown requirements of 22 kv in a standard cup, oil is filtered.

recommendations for engineering changes, and modified some circuits to give greater reliability.

Maintenance work for the scheduled down day was reviewed to determine if any component, which might subsequently fail, had been overlooked. Also, a study was made of a major mechanical problem: that of preventing high rf currents from pitting liner wall drive bearings within the vacuum tank. Modifications for improvement were installed.

Results, as indicated on the graph, tend to indicate that these efforts were justified.

The fourth key to an effective maintenance program is the adequate training of new personnel.

It is believed that much of our maintenance can best be learned by actually performing the job. Therefore, newly assigned maintenance men go directly to work, rather than attend a formalized school.

However, as we want them to begin with the simple jobs and progress to the complex, a training schedule is made up which outlines the equipment to be studied and worked on during a particular week. In this way we are sure of covering the various phases of work in the allocated training period. While progressing in this manner, the new employee is to some extent productive. The extent of this instruction period varies according to the employee's theoretical background and practical experience.

In starting a new man on his maintenance assignment, the supervisor gives him a general tour of the area and an explanation of

the 90-in. cyclotron. He is given several articles to read on the theory and construction of cyclotrons at the Radiation Laboratory. He is also given articles that tell the history of cyclotron development. This initial tour is important, as it stimulates the interest of the new employee.

Next, he is assigned for a period of time, depending on his background, to the instrument maintenance shop. Here he learns theory and develops skill in the operation and maintenance of various types of test instruments, such as vacuum-tube voltmeters, pulse generators, and oscilloscopes. Again he

learns by doing and performs some actual maintenance work during the learning process. A picture of this phase of training is shown in Fig. 19.

When he returns to the 90-in. cyclotron assignment he has the necessary knowledge on the use of test equipment to enable him to interpret his findings in the course of trouble-shooting. He is also prepared to perform minor maintenance on test equipment.

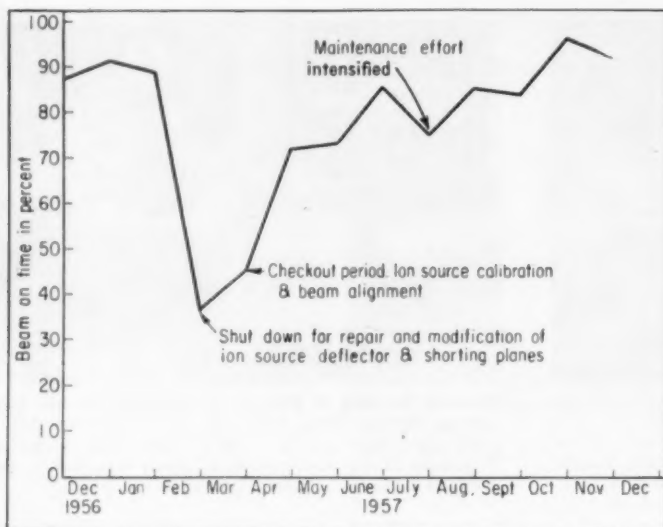
The success of the next phase of training lies directly with the cyclotron maintenance supervisor. He works closely with the new man to explain the control rack and panel numbering system. Together they study control circuit diagrams and identify the various pieces of equipment. During this period the new man is expected to learn the sequencing of the terminals on several standard panels. In this way he may do some of his trouble-shooting without the aid of circuit diagrams. As an example, if he will learn that terminals on an L relay panel connect in sequence to coil (neutral), coil (hot), normally open, normally closed, swinger contacts, etc., he can count from left to right on a terminal strip and identify some particular contact on a relay without the necessity of a control-circuit diagram.

Following the work with the supervisor, the new man is assigned equipment to repair, and is sent, with an experienced man to assist him, on trouble-shooting jobs. In both cases he progresses from the simple to the complex problem.

Experience has shown that this



17—PULSE WAVE SHAPES are checked following replacement of charging diodes in ignition contactor, part of the 500-kw rectifier. Preventive Maintenance schedules also call for routine inspection of cooling water interlock switches, visible above oscilloscope.



18—PERCENTAGE BEAM ON TIME FOR 1957. Decline during March was due to scheduled modification and repair of components within vacuum tank. On time increased during subsequent testing period of April. Climb back to high reliability was made with intensified maintenance effort.

approach to training personnel resulted in a group of highly competent maintenance people.

The fifth key to any effective maintenance program is that there be replacement parts readily available when needed.

Many of those concerned with maintenance work can testify to the seriousness of a situation when equipment breaks down and there are no replacement parts available.

In order to minimize down time of the machine, it is not always expedient to replace a given compo-

nent. Experience has shown that it is much faster to replace an entire chassis. Therefore, certain chassis are duplicated and stored, to be installed should a breakdown occur. Many of these chassis are seen in Fig. 20. Following its replacement, a defective chassis is delivered to the maintenance shop, where it is repaired, then placed on the storage rack so as to be available should another breakdown occur.

With more electronic circuits finding their way into automati-

cally controlled systems, it is increasingly important that this equipment be designed for easy trouble-shooting and repair. Otherwise, the economies that the electronic devices sought to provide are more than balanced by excessive trouble-shooting and maintenance time, caused by unnecessary complexity of circuits and layout.

After the system has been properly designed and installed, a planned maintenance program to meet the particular need should be initiated.

It is hoped that this article has offered some practical, or helpful suggestions to those interested in either design or maintenance, that in the beginning the maintenance man is not forgotten.

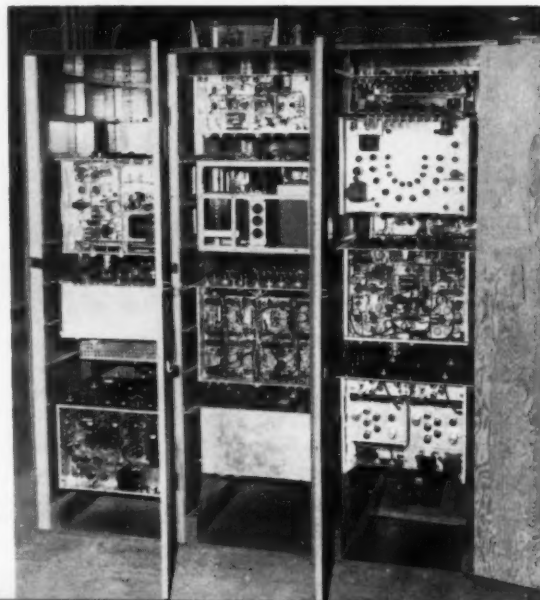
The author wishes to acknowledge contributions made by Electronics Department personnel who initially designed the control system, and those who through the years have had a share in bringing about improvements. Without their foresight and knowledge of maintenance problems our methods of trouble shooting and locating failures would not be possible today.

Also the effective maintenance program is made successful through the joint efforts of Coordination, Engineering, Operations, and Maintenance Groups who strive continually for improved machine reliability. Their cooperation and efforts are sincerely appreciated.



19—INSTRUCTION OF NEW EMPLOYEES includes work in Instrument Overhaul Shop under guidance of Supervisor A. J. Eldridge. Here he studies oscilloscope operation and maintenance which, together with other instruments, constitutes a field-maintenance trouble-shooting tool frequently used.

20—CHASSIS ARE REPAIRED and placed in storage cabinets. Some are duplicates of chassis essential to cyclotron operation. Maintenance often replaces a malfunctioning chassis with a spare while repair is made on the original. Other chassis are installed at request of physicist to assist in recording of experimental data.



DUE TO SPACE LIMITATIONS and sudden drop-off of terrain, outdoor bus structure and series of transformers for electrical expansion and modernization program were installed in line closely adjacent to wall of Philadelphia exhibition hall.



*Electrical modernization program
provides high capacity for . . .*

Trade Show Power Supply

New substation, control center, distribution system, lighting installation and air-conditioning equipment restore usefulness and desirability to aging Philadelphia arena.

By Charles L. Betts, Jr.

AN INTEGRATED group of municipal buildings in Philadelphia, formerly known as the Commercial Museum and Convention Hall, recently has been renamed and electrically modernized to more-adequately serve the needs of present-day conventions and trade shows. This necessity for modernization is readily apparent when it is known that the museum was built shortly after the turn of the century, and the auditorium was erected three decades ago; i.e., before the era of prevalent air conditioning, high-intensity illumination and sizable motor loads.

Now, renamed the Trade and Convention Center, the buildings are equipped with a modern million-dollar air-conditioning system; the electrical system has been expanded; and the lighting installation is slated for modernization in the near future. Physical rehabilitation has also included the addition of a reference library, facilities for entertaining visiting dignitaries, numerous permanent displays prepared by the city's planning board, plus several office sections for operating and management personnel.

Power requirements for the modernized exhibition hall were specified by Ewing Technical Design, Inc., consulting engineers, who cooperated with the city's division



MODERN METAL-ENCLOSED SWITCHGEAR was added to house main breaker, branch switches and submetering equipment. Total available power for 100,000-sq-ft display area amounts to 3000 kva, with 110-, 220- and 440-volt service available for this purpose.

of Communication and Engineering Services. Actual electrical installation was by the Charles E. Tull Co., Philadelphia.

The exhibition hall (a high-bay structure encompassing 100,000 sq ft of display area) now provides a wide selection of power facilities from over 60 convenient locations. These facilities include single-phase and 2-phase 5-wire 110/220-volt service; 3-phase 3-wire 220-volt, and 3-phase 3-wire 440-volt power provisions. Total available

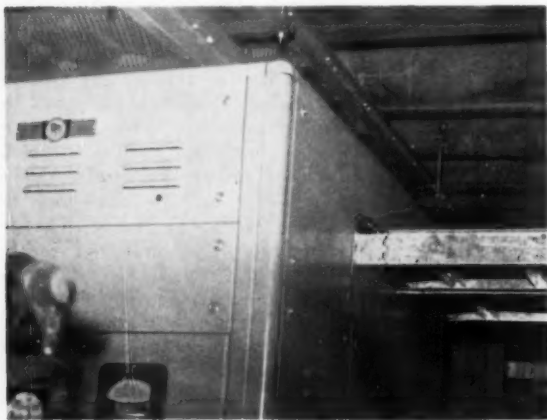
power for display purposes amounts to 3000 kva obtained from three 1000-kva transformers which, in turn, are served through a 15-kv 3/c underground feeder that connects the convention hall's 13.2-kv bus structure with an outdoor substation. Transformers are equipped on their high-voltage sides with fused disconnects, and, due to limited space plus the steep nature of the terrain, the three transformers are placed in a row, located adjacent to one wall.

Secondary switchgear is located indoors, adjacent to this same wall, so that secondary buses can be minimized in length. In piercing the wall, the 440-volt buses are located at the top, those related to 220-volt 3-phase power in the center, while the 110/220-volt 2-phase 5-wire buses are placed at the bottom to avoid necessary cross-overs in bus arrangement.

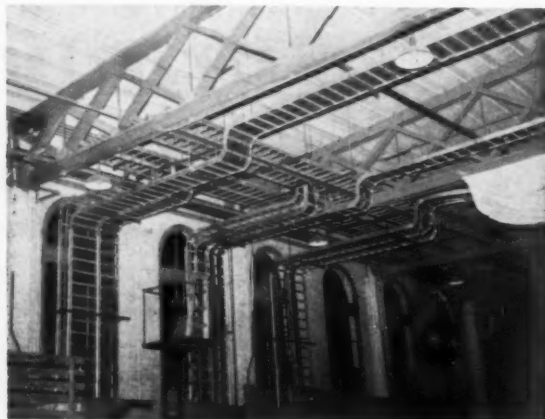
Separately-housed 600-volt ACBs related to these secondary bus structures are, respectively, a 3-pole 1600-amp-, a 3-pole 3000-amp- and a 4-pole 2400-amp unit. Each switchgear assembly contains a separate bus structure that connects the main breaker with 12 separately compartmented fused branch circuit switches. Branch circuit switches are all rated for 400 amps at 600 volts, although time-lag fuses presently limit these ampere ratings to 250. And, to accurately check loading on each service, polyphase watt-hour meters are provided for that purpose.

Overhead Cable Racks

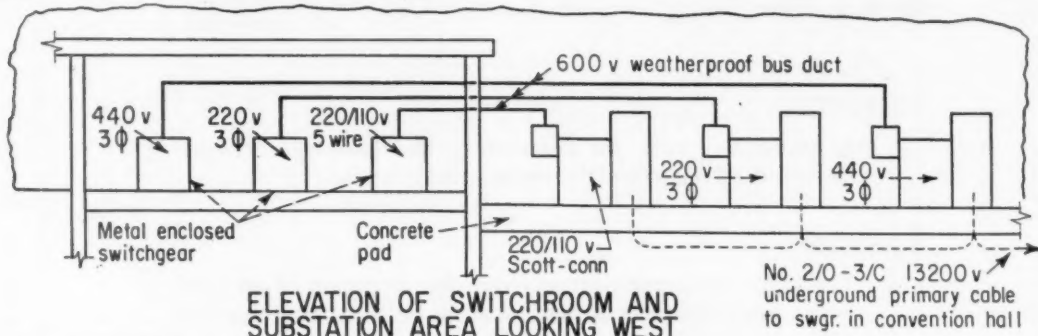
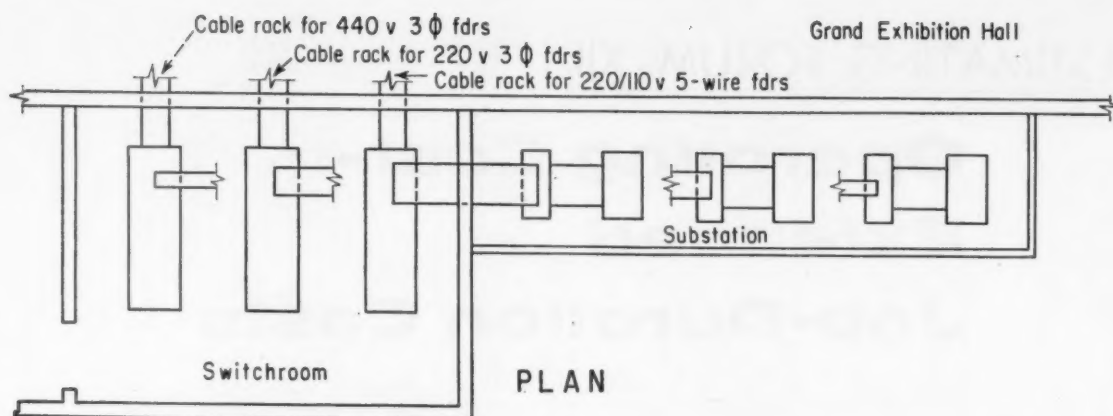
Since the floor of the exhibition hall is constructed directly on ground, the cost of an underground distribution system would have been exorbitant, inflexible and inconvenient for accessibility. Therefore, after verifying the fact that existing roof-trusses and columns could safely support the additional loading of branch circuitry, it was decided to install a rather intricate system of cable racks at truss heights varying from 22 to 35 ft above the floor.



LADDER CABLE RACKS are used both for support of incoming feeders to switchgear (right) and outgoing branch cables (top left). Racks vary in width depending on extent of cabling to be carried; are galvanized to negate corrosion and painting.



INTRICATE DISTRIBUTION system of cable racks carries three types of electrical branch circuiting throughout exhibition area at truss levels that vary from 22 to 35 ft in height. Overhead solution negated impractical underground system.

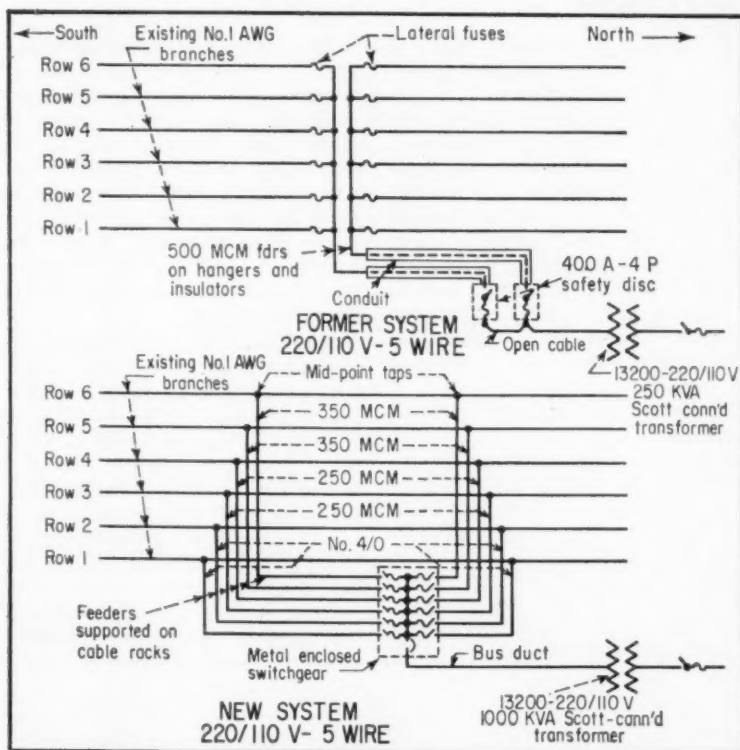


IN-LINE ARRANGEMENT of outdoor transformers and interior switchgear minimizes and simplifies busduct connection details. Primary service to substation is underground from main 13.2-kv switching center. Secondary distribution is overhead, via racks,

These ladder-type racks (with rungs spaced on 9-in. centers) vary in width from 12 to 24 ins. (depending upon number of branch circuit cables being supported thereon). Racks are furnished in 12-ft lengths; are fabricated from 14-gauge galvanized steel (to resist corrosion and eliminate the added cost of painting and maintenance); are pinned together at junction points, and are supported (at 12-ft intervals) either by existing beams or by prefabricated steel channels and hangers.

This modernized distribution system now provides 440-volt power for use in the three middle bays of the hall; 220-volt 3-phase service for the four center bays, and 110/220-volt current for these same four middle bays plus both lateral wall areas. Expansion of this coverage is already provided for by spare cable racks and blank switchgear cubicles.

When the complete project is terminated (with more-efficient lighting fixtures and controls), this exhibition hall will be able to resume its former status as a convention and display center where power and lighting facilities are sufficient for all requirements and occasions.



COMPARISON of former and present distribution systems related to 220/110-volt service in exhibition hall indicates four-times boost in capacity, introduction of busduct feeder and new switchgear, revised tap arrangement and variable sizing of cables to branch mid-points.

Operating Cost- Extended Job-Duration Costs

By Ray Ashley, Research and Consulting Engineer, Oak Park, Ill.

QUESTION:

Is there any rule for estimating the cost of extended duration of electrical installations?

ANSWER:

Yes. The estimated cost of extended duration of an electrical installation is approximately 10% of the contract price divided by the normal duration, in months.

DISCUSSION:

The studies of extended duration costs appearing in the accompanying chart were made when the prevailing labor rate for electricians was approximately \$2.00 per hour. Since that time, material and labor costs have increased greatly. But the formula still applies because the month's duration for a given volume have gone down in proportion. The chart shows a 7-month duration period for a \$100,000 project. Today, a contract for \$180,000 or more would be assigned a 7-month duration.

Duration periods, and costs of extended duration, depend a great deal on the M/L (Material-Labor) ratio of the cost. The studies in the accompanying chart are based on an M/L ratio of 60% Material and 40% Labor.

To illustrate the "cost of extended duration rule" we will use a \$200,000 project with a normal duration of eight months. The estimated cost of extended duration would be:

$$\begin{aligned} \text{Cost/month of extended duration} &= 10\% \text{ of contract price} \\ &= \frac{\text{normal month's duration}}{0.10 \times \$200,000} = \$2,500 \\ &= \frac{8}{8} \end{aligned}$$

At a glance, the \$2,500 per month appears to be a great deal of money. A study of the chart, however, reveals that this sum is assigned to many items. The major cost is excess labor and the attendant increase in job costs. Key men and tools are tied up, supervision continues, insurances add up and the contractor's entire organization must stand ready to wait on the dragging project.

Since labor is the principal item of extended duration costs, it follows that the lower the M/L ratio, the greater the cost. In our example of a \$200,000 project with a 60-40 M/L ratio, the estimated cost per month for extended duration was \$2,500 or 1.25% of the selling (contract) price. For a \$200,000 installation-only (supplying only labor and labor services to install material furnished by others) contract, the cost-per month for extended duration would be approximately 2.5% of the contract price.

Expressed in percentage of selling price, the cost of extended duration goes down as the size of the project increases. This is because the duration time does not increase in proportion to volume.

Before accepting the formula for a particular job, the estimator must study the values in the accompanying chart to see how well they apply to the work at hand. Completed contracts should be reviewed and detailed estimates prepared.

The dragging of a minor portion of a contract may not be serious enough to be considered as extended duration of the entire project. The \$200,000 job noted in the example may include yard lighting amounting to \$1,000. The work may all be completed on schedule, except the yard lighting which involved a three-month delay. These three months could not be considered as extended time for the main contract. Cost of delay for this minor portion of the job would require a separate estimate.

One should not confuse shut-downs (where entire job is shut-down and no work at all is done) with extended duration. A considerable amount of good judgment and careful analysis is required to accurately estimate extended duration costs. For a more detailed study of this subject see pages 159, 163 and 171 in *Electrical Estimating* (McGraw-Hill Book Company).

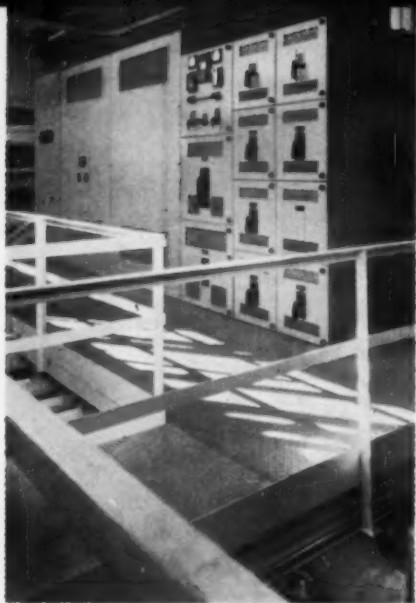
ESTIMATES OF EXTENDED DURATION COSTS FOR ELECTRICAL CONSTRUCTION PROJECTS-INDUSTRIAL (SEE NOTES BELOW)

ITEMS OF OPER. COST	I-\$50,000.(SELL PR.)PROJ.				II-\$100,000.(SELL PR.)PROJ.				III-\$500,000.(SELL PR.)PROJ.				IV-\$1000,000.(SELL PR.)PROJ.						
	NORMAL COST		EXT.TIME		NORMAL COST		EXT.TIME		NORMAL COST		EXT.TIME		NORMAL COST		EXT.TIME				
	THE JOB %OF \$ LAB.	PER MO.	COST/MO. %OF \$ NOR.	THE JOB %OF \$ LAB.	THE JOB %OF \$ LAB.	PER MO.	COST/MO. %OF \$ NOR.	THE JOB %OF \$ LAB.	THE JOB %OF \$ LAB.	PER MO.	COST/MO. %OF \$ NOR.	THE JOB %OF \$ LAB.	THE JOB %OF \$ LAB.	PER MO.	COST/MO. %OF \$ NOR.				
ESTIMATING	1.25	160	32	—	1.0	272	39	—	—	0.75	1,125	75	—	0.70	2,100	105	—		
ENG&PLANS-INCL.FIELD ENG	2.75	352	70	20	14	2.5	680	97	20	2.0	3,000	200	20	40	2.0	6,000	300	20	
FIELD SHOP & OFFICE	0.5	64	13	25	3	0.4	109	16	25	4	0.2	300	20	25	5	0.2	600	30	20
TEL.	0.3	39	8	50	4	0.2	54	8	50	4	0.2	300	20	40	8	0.2	600	30	40
WIRING&POWER-FIELD	0.2	26	5	20	1	0.2	54	8	12	1	0.2	300	20	10	2	0.2	600	30	20
TOOLS-CONSUMED&DEPR	3.5	450	90	20	18	3.5	952	136	20	27	3.25	4,875	325	20	65	3.1	9,300	465	20
TIME KEEPER - PRORATA EXP	INCL IN OH				—	—	190	27	50	14	0.7	1,050	70	50	35	0.7	2,100	105	60
SUPERVISION	2.75	352	70	60	42	2.5	680	97	50	49	2.5	3,750	250	50	125	2.5	7,500	375	50
COORD. DEL-TO EXPEDITE LAB	0.3	39	8	50	4	0.2	54	8	50	4	0.18	270	18	50	9	0.18	540	27	50
TRAVEL EXP-OFFICE TO JOB	0.25	32	6	50	3	0.2	54	8	50	4	0.15	225	15	40	6	0.15	450	23	45
INSURANCES&BENEFIT FUND	14	1,792	360	—	—	14	3,808	544	—	—	14	21,000	1,400	—	—	14	42,000	2,100	—
INTEREST ON PAYROLL	0.5	64	13	—	—	0.5	136	20	—	—	0.5	750	50	—	—	0.5	1,500	75	—
ASS'N DUES	0.7	90	14	—	—	0.7	190	27	—	—	0.7	1,050	70	—	—	0.7	2,100	105	—
PRORATA CHARGES	0.3	39	8	50	4	0.2	54	8	25	2	0.2	300	20	20	4	0.15	450	23	20
INSPECTION & PERMITS	0.8	102	20	—	—	0.8	218	31	—	—	0.8	1,200	80	—	—	0.8	2,400	120	—
RES.FOR CONTING.&GUARANTEE	5	640	128	—	—	5	1,360	194	—	—	5	7,500	500	—	—	5	15,000	750	—
DIRECT JOB COSTS-LABOR	33.1	4,241	845	—	93	326	8,865	1,268	—	129	3133	46,995	3,133	—	299	3108	93,240	4,663	—
LABOR OVERHEAD	22	2,816	563	50	28.1	4,896	700	45	—	315	14.5	21,750	1,450	40	580	138	41,400	2,070	40
MATERIAL SERVICE RES.& OH.	9% OF MAT.	1,728	346	20	70	3,264	467	20	93	875% MAT.	15,188	1,012	20	202	6% OF MAT.	27,000	1,350	20	270
TOTAL OPERATING COSTS		8,785	1,754	444		17,025	2,434		537		83,933	5,595		1,081		161,640	8,083		1,554
DIRECT LABOR INCREASE/MO	4%			512	285%				775	133%				2,000	1%				3,000
INS.& BEN.FUND INCR./MO.				72					108					280					420
TOTAL COST PER MO.				1,028					1,420					3,361					4,974

NOTES:-

- 1-ESTIMATES ARE FOR "60/40" PROJECTS (BASE COST 60% MAT & 40% LAB) WITH \$2.00/HR LAB & A 5 DAY WEEK
- 2-RES. FOR CONTING INCLUDES ALLOW FOR INCIDENTALS, ADJ. FACTOR, ETC.
- 3-ESTIMATES INDICATE THAT DOUBLING THE NORMAL DURATION PERIOD WOULD INVOLVE AN ADDITIONAL EXPENSE OF APPROX. 10% OF THE CONTRACT PRICE. EACH MONTH WOULD BE IN PROPORTION

EXAMPLE- COST PER MO.(EXTENDED TIME) FOR A \$100,000 PROJ.(NOR DURATION 7MO.) WOULD BE APPROX.
(10% OF \$100,000)÷7 = \$1428. (EST. SHOWS \$1420.)



UNIT SUBSTATION, one of the nine throughout the factory installed on roof-truss platforms. Each unit consists of an incoming high-voltage interrupter switch cubicle; an air cooled transformer section; and a low-voltage air circuit breaker distribution section.

Modern High-Voltage Distribution

at Automatic Electric Company's new plant in Northlake, Ill. Underground supply is extended through interlocked armor cables that provide primary distribution at 4160 volts. Utilization is served through 277/480-volt bus duct distribution for power and lighting.

By: J. H. McVey, and E. G. Ross, *Vice President and Project Engineer, The Austin Co.; Senior Electrical Engineer, The Austin Co.*

THE new plant, which occupies a former 167-acre country club site, is 15 miles northwest of the Chicago business district. One of the largest industrial buildings in mid-America, it is a prime example of modern, industrial architecture and engineering, plus the latest in construction methods and materials. Its 35-acre roof houses an integrated layout of plant, office and research sections, and the combined electrical systems would serve a community of 12,000 people. At the present time the plant has 8,400 employees whose activities were formerly carried on in 17 multi-story buildings (total of 75 floors) located near the Chicago loop. Parking facilities include well lighted areas for 5,000 cars.

The flat-roofed, steel-framed factory structure possesses an inherent flexibility which permits the arrangement of all handling, processing, storage, assembly and shipping functions in an orderly, straight-line sequence. This enabled the plant to achieve real unity of operations in record time.

The plant's electrical system, which was installed by electrical contractors Emerson, Comstock Co., Inc., and Monroe Electric Co., is both extensive and modern.

Two Public Service sub-transmission lines of 34.5 kv each feed

a main outdoor substation housing duplicate 5000-kva transformers that step-down the 34.5-kv energy to 4.16-kv power for primary distribution. A transfer bus between the two incoming lines makes each transformer capable of handling approximately two-thirds of the plant's total connected load. Besides the two main air circuit breakers, one tie air circuit breaker and ten feeder air circuit breakers, the main substation has space designed to hold one future 5000-kva unit which will also be connected to the transfer bus section. Total connected load of the plant is 19,931 kva and estimated maximum demand load on the Public Service substation is approximately 11,350 kva.

Eight runs of 4-in. Transite ducts encased in a concrete envelope, each containing 3-1/C, 350 MCM cables, carry the 4.16-kv power underground to the manufacturing building. Three circuits of 3-1/C, No. 2; 3-1/C, No. 6; and 3-1/C, No. 4/0 self-supporting aerial cables form an overhead system to provide power to the boiler house, fire pumps and wells. Where the eight lines of 3-1/C, 350 MCM cables enter the manufacturing building's west wall they were spliced directly to 3/C, 350 MCM interlocked armor cables by means

of a standard splice kit. Ladder-type cable trays ranging in width from 9-in. through 24-in. support the armor cables as they continue overhead to supply the in-plant primary radial distribution system. The 5-kv interlocked armor cables feed 11 secondary selective unit substations plus two non-selective substations. Nine of these 13 substations are mounted on truss-supported platforms at load center locations throughout the plant.

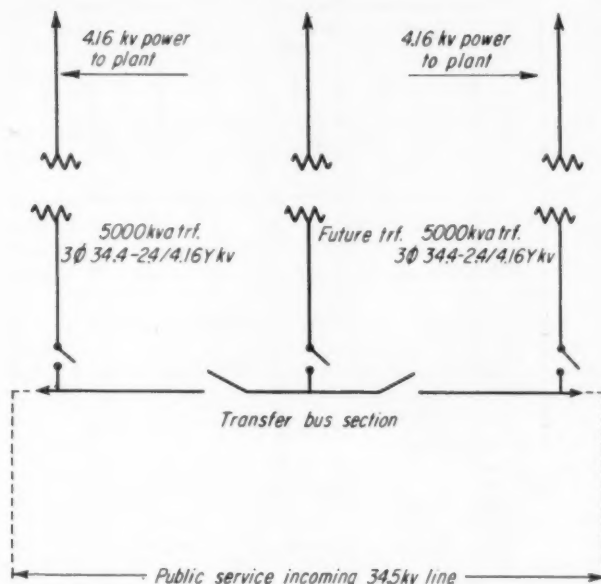
Each unit substation consists of an incoming section with high-voltage interrupter switch, a transformer section with air cooled transformers, and a low-voltage air circuit breaker distribution section. Through secondary ties of two 4-wire interlocked armor cables that consist of 3-500 MCM and 1-4/0 conductors, the secondary load of one substation can be carried by another. The load is transferred automatically, and each unit is capable of handling approximately two-thirds of the total load of both until trouble is corrected. For example: substation "A" has a total demand load of 1337 kva and is connected through secondary ties to substation "D", which has a demand load of 1453 kva. If substation "A" should break down, substation "D" would handle 72% of the demand load of both. Auto-



SUPPLEMENTARY LIGHTING in relay panel assembly and test area boosts illumination to 100 fc. Fixtures are rapid start, two-light, 40-watt, industrial type RLM units.



RECEIVING AND STORAGE bay features two overhead $7\frac{1}{2}$ -ton cranes with interconnecting hoists. The vast area is well lighted by the 277/480-volt lighting system.



ONE LINE DIAGRAM details location of transformers and transfer bus section in main outdoor substation.

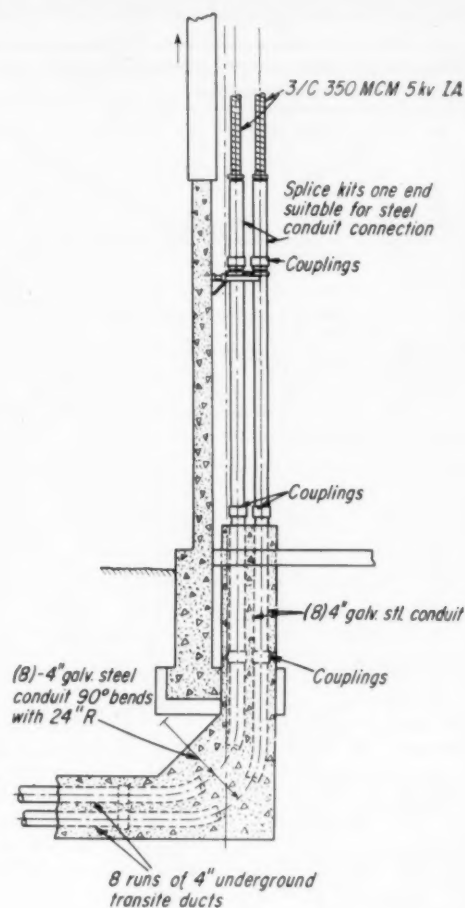
TRANSITION FROM underground primary ducts to overhead interlocked armor cables serving eight in-plant unit substations.

matically operated signal lights come on to indicate load transfer and go out again when normal service is restored.

Substations provide secondary utilization voltage of 277/480 volts for general fluorescent lighting and power. Other utilization voltages for the various systems are listed below:

Primary Service	34,500	3-phase	3-wire
Primary Distribution	4160	3-phase	3-wire
Power System No. 1 (large motors)	4160	3-phase	3-wire

Power System No. 2	2400	3-phase	3-wire
Secondary Distribution	277/480	3-phase	4-wire
Power System No. 3	480	3-phase	3-wire
Lighting System No. 1	277/480	3-phase	4-wire
Lighting System No. 2	120/208	3-phase	4-wire
Special System	120/240	3-phase	4-wire
Special Testing System	12/24/48	dc	2-wire



In-plant secondary distribution is supplied by 11,540 ft of aluminum bus duct. It is designed to operate on a 277/480-volt, 3-phase, 4-wire grounded system with 400-amp capacity. This is supported every 5 ft by means of steel rods connected to the building roof

trusses. The plug-in bus plugs are of the fusible type and will serve the general lighting and power equipment of the entire building. All other wiring, not including primary distribution, is contained in rigid conduit. This includes feeders, branch circuits and drops to machinery. Short connections to fixtures and motors are in flexible metallic conduit. Thinwall is used only in the office and laboratory sections.

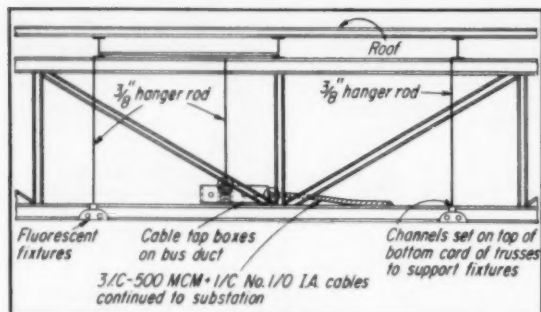
Five emergency gas driven engine-generator plants, ranging in size from 18.75 kva to 43.5 kva, supply electrical energy for emergency lighting in the manufacturing and office buildings. The engines are equipped with 100 amp-hour, 12-volt starting batteries and a 12-volt

charging generator with an automatic charge regulator. Automatic controls start the engines and transfer loads whenever service fails, besides shutting them down automatically when normal service is restored. In addition, one 187.5-kva, 480-volt, 3-phase, 3-wire emergency turbo-generator is installed in the boiler house complete with automatic transfer switch to provide energy for emergency heating.

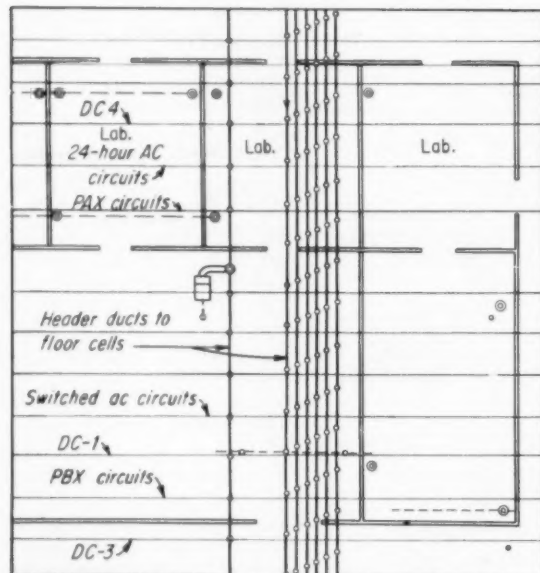
Two large centrifugal refrigeration compressors with a total capacity of 1200 tons serve a chilled water system that supplies air conditioning to 95 separate zones, with each zone governed by its own thermostatic controls. The two 600-ton units are centrally located underground with respect to the areas

they serve. The entire third floor of the office building is devoted to a fan room that has a total air handling capacity of 140,000 CFM. A separate supplementary air conditioning system was also installed to provide cooling for the large number of office business machines in use.

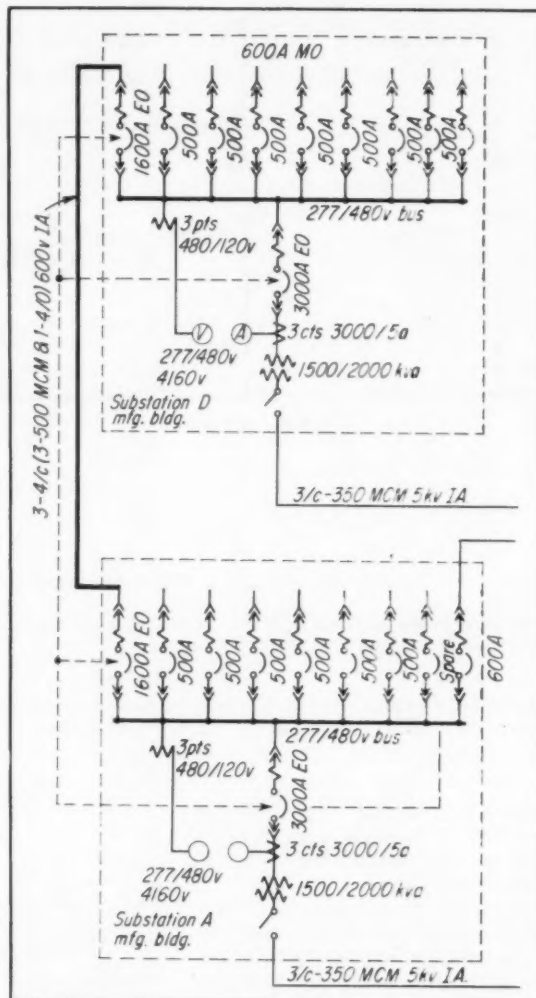
The plant is illuminated by an extensive 277-volt fluorescent lighting system. The fixtures contain over 35 miles of fluorescent tubing which provide even, glare-free areas, ranging from 30 fc in the shipping and receiving departments, to 45 fc in the metal working and stockroom locations, and from 65 to 100 fc in fine assembly areas, office, engineering and laboratory sections.



MOUNTING DETAILS of fluorescent fixtures and bus duct as they are located in roof trusses of manufacturing building. Note cable tap box that connects interlocked armor secondary cables to bus duct section.



PARTIAL DIAGRAM of one of the sections of header ducts which supply feeders, sub-feeders and cross feeders to under-floor cellular steel raceway on both floors of the research building. The cellular raceway provides complete distribution of eight independent systems needed for testing and experimental purposes in this section of the overall plant.



ONE LINE DIAGRAM of two typical substations. Note secondary ties.



RECESSED TROFFER UNITS, containing two 40-watt rapid start lamps and installed in 24-ft sections located on 6-ft centers, provide the factory general office with 65 fc of illumination.



277/480-VOLT LIGHTING system over the coil-winding department provides high intensity lighting that prevents eye-strain for the workers and reduces mechanical errors. The fixtures are three-lamp, high output, 8-ft units.

Fixtures in the factory are of the RLM industrial type fluorescent. They range in size from two 100- and three 100-watt high output 8-ft units to two 40- and three 40-watt 4-ft rapid start types. In general the fixtures are attached to continuous rows of metal framing that combines a supporting media with a raceway for lighting circuits. All home runs are No. 10 conductors, while taps from junction boxes to the fluorescent units are made with No. 12 wire.

In most cases, the continuous fixture support rides on the bottom cord of roof H-section trusses with intermediate steel rod hangers from roof purlins at 20-ft intervals. The 11,540 ft of bus duct installed throughout the plant is supplied in a similar manner with steel rod hangers on 5-ft centers. Keeping both fixtures and bus duct at truss chord level permitted installation of 2700 ft of monorail track suspended from the bottom roof truss.

Special consideration had to be given to the lighting system in two departments where extra high intensity lighting was required because of fine assembly work and final testing operations. This was achieved by adding supplementary lighting beneath the general lighting system in the form of 2-lamp, 4-ft, industrial type, rapid start, RLM units installed in 12-ft sections and located on 5-ft centers. Through the installation of this supplementary lighting system, plus general overall lighting, high-

intensity illumination for precision work was brought about by being able to maintain a level of over 100 fc.

In the factory general office, fixtures are rapid start, 2-lamp, recessed troffers with Abolite lenses. These units, installed in 24-ft sections, are located on 6-ft centers and provide the area with 65 fc. In the drafting and engineering departments, 3-lamp, rapid start, recessed troffers, on 6-ft centers, maintain a lighting level of 100 fc.

Individual transformers provide service for the 115-volt lighting and receptacle circuits where required. These transformers are of the 3-phase, air-cooled, insulating type with 480-volt delta primaries and 120/208-volt secondaries.

The waffle-type, lift-slab construction of the two-story research building posed an interesting problem of flexible distribution of eight independent electrical systems. These included: private automatic telephone; public telephone; 24-hour ac system; switched ac system; and four dc and transfer systems for testing.

Conventional underfloor duct systems could not be obtained with enough parallel ducts to service all systems. Application of several duct systems was ruled out because of configuration difficulties, cross-overs and limited slab thickness. The solution lay in the installation of a single duct system that would accommodate all systems and still keep total floor thickness within

reasonable limits. Cellular steel flooring was the answer.

After the lift-slab was in position, cellular flooring was laid on top for the use as electrical raceways and not as a load-bearing structure. The cellular floor was installed from wall to wall to provide approximately 312 individual paralleled "cells" as electrical raceways for almost unlimited distribution of the eight systems involved. For example: on one floor eight main header ducts run transverse to the cells feeding pre-assigned cells with circuits from each of the eight electrical systems. In addition 22 sub-headers and cross feeds were installed to accommodate anticipated changes and additions.

In general, individual cells are tapped at pre-determined locations to provide branch circuit access. Future extensions or additions can be easily installed by cutting through the light-weight 2½-in. concrete topping over the cellular floor with diamond-tipped hole-boring drills. Conventional hole-saws then cut through the cell structure. Standard floor-duct fittings are then installed to complete the outlet.

In a number of cases, the eight electrical systems had to be connected to a series of laboratory work benches. Where this occurred, a short 2½-in. nipple was threaded into a cross header and fitted with a common junction box. Flexible conduit was used to carry the systems from box to various loads.

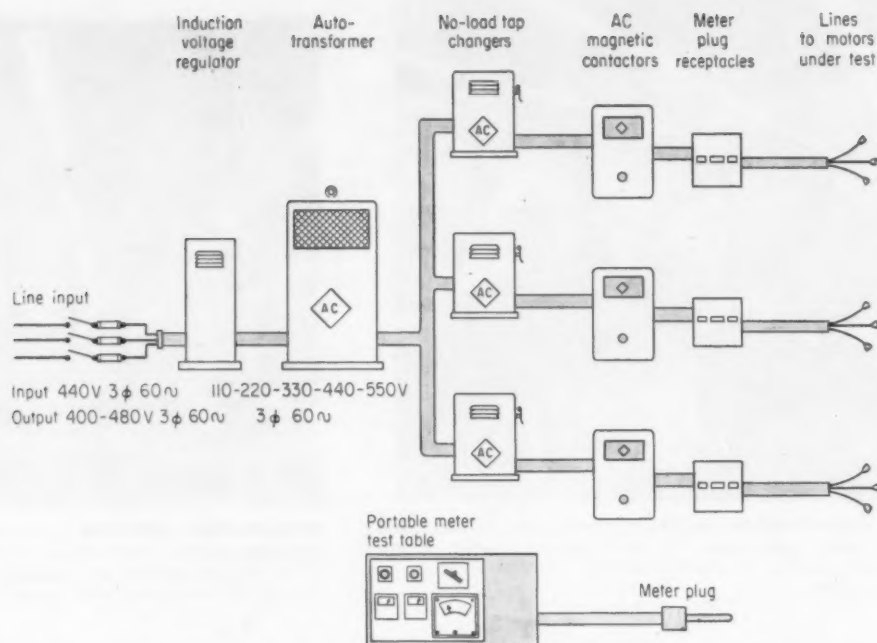


FIG. 1—Layout of induction motor test stand showing component equipment used to provide variety of test voltages. Portable meter test table plugs into meter plug receptacles. Three "stands" are shown.

Induction Motor Test Stand

... simplifies volume motor testing and trouble shooting. Variations of design can be applied to motor shop service facilities.

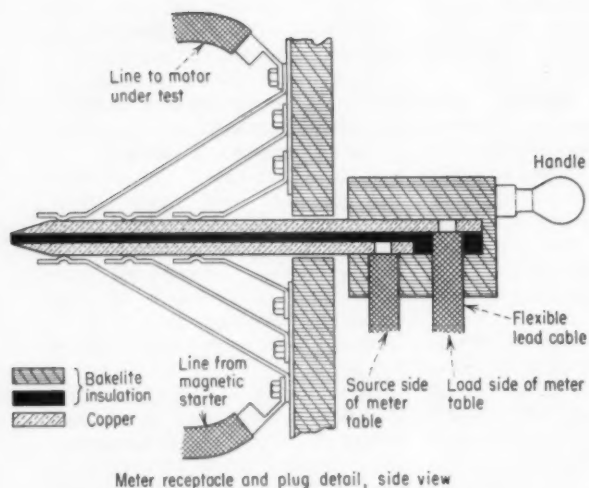


FIG. 3—Cross-sectional view of meter receptacle and meter plug construction. Note paralleled spring-bronze receptacle contacts and "sandwich" design of plug contact plus insulating feature of plug handle.

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Variety of Test Voltages

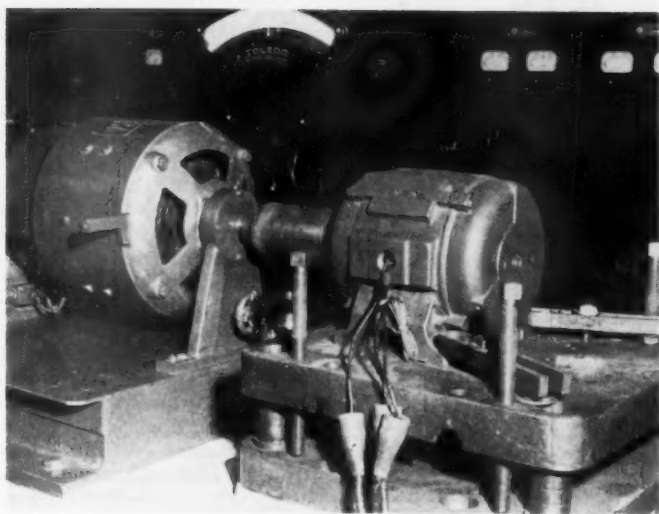


FIG. 2—Motor platform is a discarded 4-pin die block with four leveling screws to align motor shaft with load machine. Test leads terminate in spring clips.

TESTING and trouble shooting of 3-phase induction motors can be both simple and easy for the motor service shop. Adequate test facilities will permit shops to increase their volume without adding to overhead. The simple test stand described in this article is basically foolproof, inexpensive and extremely versatile.

While the equipment involved is above the "hook on" class in both material and installation labor cost, it is accurate to $\frac{1}{2}$ of one percent in current readings and $\frac{1}{2}$ of one percent in watts. With minor alterations this test stand, developed by The Norwood Works Development Laboratory of the Allis-Chalmers Mfg. Co., can be changed for a variety of applications.

Equipment for this multi-test stand includes a suitable fused disconnect switch, induction voltage regulator, autotransformer, three no-load tap changers, three meter plug receptacles, one portable meter test table, and three test blocks for mounting the equipment. The complete system shown in Fig. 1 permits three tests of different character and different voltages to

be made simultaneously. A 3-phase, 440-volt, 60-cycle power source is necessary. However, any voltage can be used if the equipment is matched thereto. All equipment, except induction voltage regulator and autotransformer, should be conveniently mounted on a poured concrete base about 30 to 32 in. high so a man can work over it without stooping.

Die-Block Motor Platform

If motors are to be tested by direct coupling to a load machine, dynamometer, or other source of load, a good method of aligning shafts is to use a discarded die block for raising or lowering the motor. Such blocks usually are obtainable from motor, transformer, fan and small appliance manufacturers; should be of the 4-pin and bushing type; and should be bolted to the concrete base. Four vertical adjusting screws, in drilled and tapped holes near the pins, are used to raise or lower the motor on test (see Fig. 2). Bolted clamps on the die block securely anchor the feet of the motor frame.

Combination of an induction voltage regulator and an autotransformer provides a practical method of obtaining voltage regulation and range when cost is important. Incoming 440-volt power is connected to a 3-phase, 440-volt induction regulator which provides a range of approximately 400 to 480 volts in continuous steps at the output side. The regulator holds the input voltage at the desired level and the voltage taps on the autotransformer provide test voltages of 110, 220, 330, 440 or 550. The no-load tap changers in the test circuit permit quick and easy shift of voltages at the test blocks.

These tap changers can be made up or be a simple link and stud arrangement. No-load tap changers in a wide range of capacities are available from transformer manufacturers. In a given test setup, the number of tap changers can be increased or decreased according to the demands made on the system. The system can be enlarged to meet the total kilowatt demand for each section. Total demand should be considered when the initial layout is made. For example, a 50-kva transformer in the initial layout cannot be expanded into a 100-kva system, but a 100-kva transformer could be used for an initial 50-kva system and also take care of expansion of that system if required at a later date.

With respect to test voltages mentioned, it is also useful to have a 660-volt tap. This can be used to simulate the load of an induction motor even though the motor would be running idle. When a 440-volt motor is run idle at 660 volts, approximately full-load current is flowing in the windings. Raising or lowering the voltage until full-load current flows in the windings determines if any connections or turns-per-coil in the motor are wrong. It cannot be used to measure temperature rise, since the watt input is lower than for full load. Voltage taps on the autotransformer can be altered to meet individual requirements. The given voltages are considered standard in the motor industry. While 330 volts is not standard, it is used on idle heat runs to induce full-load current in 220-volt motors to test for shorted coils.

Motors under test are controlled (started and stopped) by the 3-pole single-throw contactors, usually

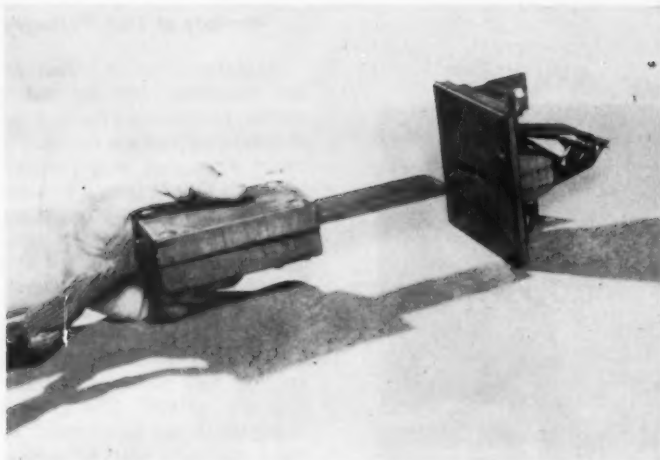


FIG. 4—Single-phase meter plug and receptacle details. Tongue of plug is two layers of copper bar with insulation between. Receptacle contacts spring together when plug is removed.

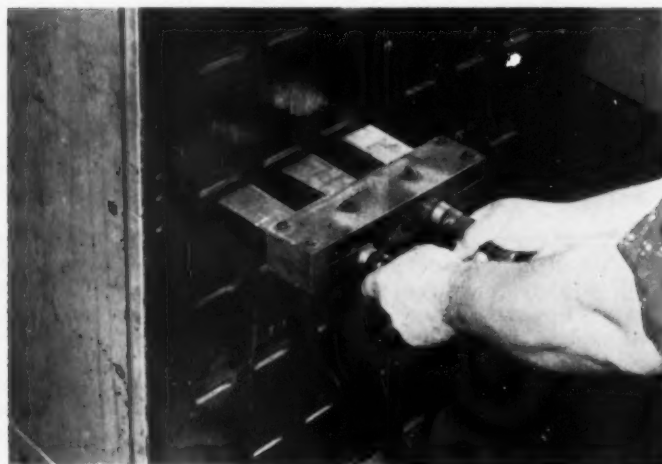


FIG. 5—Three-phase meter plug, of similar construction, is being inserted into meter-plug receptacle panel. Dual handle facilitates plug alignment.

magnetically operated, in the test circuit. These also act as disconnect switches for a particular test stand. Current ratings and voltage interrupting capacity are determined by the individual needs of the user. The entire system must be designed for a definite maximum current and voltage rating and the appropriate equipment and meters selected accordingly.

Portable Meter Table

A meter-plug receptacle is permanently installed between the magnetic contactor and the motor test

leads. This permits quick insertion of a meter in the test circuit. Fig. 3 is a cross-sectional view showing the construction of the receptacle and meter plug. The assembled components of a single-phase meter plug and receptacle are shown in Fig. 4. A 3-phase meter plug is being inserted into a receptacle panel in Fig. 5. With this arrangement, meters can be used under any load condition. Maximum recommended voltage is 660.

Receptacles must be designed for current carrying capacity. By placing several spring bronze contacts in parallel, more current can be

carried and three heat-run tests run at the same time. Two heat runs could be made on two stands and a speed-torque curve test on the third, even at a different voltage than that used with the initial heat runs.

The meter table itself can be of any convenient design. It should be on wheels to make it portable and have hinged lids to protect the instruments. Fig. 7 shows a portable meter table with relay-operated controls on a backboard panel. Basic wiring diagram for the meter table is shown in Fig. 6.

With the ammeter transfer switch, one ammeter can be used to measure current in all three phases. The current transformer secondary is always shorted, either by the ammeter or by the meter phase transfer switch. Because extremely high voltages are generated, current transformers are dangerous when their primaries are excited and secondaries are open. The secondary circuit of any current transformer should always be shorted either with a wire, automatically with a switch or with a meter.

A voltmeter transfer switch permits measurement of all three-phase voltages with a single meter.

Phase "A" of the wattmeter current coil must be matched by the phase "A" voltage on the wattmeter potential coils. The voltage pickup for the table should be on the load side and at the extreme end of the cable leaving the table. A separate No. 14 wire should be used for this purpose, and the voltage pickup should be located at the fingers of the jack.

Starting at the motor terminals and working back to the power source, each test block must have a set of clip-leads capable of carrying the maximum design current. The clip-end of these leads are connected to the motor while the other end is connected to the bottom clips of the meter table jack which is connected to the load side of the ac magnetic contactor. From the line side of the contactor, lines go to the no-load tap changer. If larger than 25 hp, these tap changers probably will be installed on a separate switchboard.

Meter-Coil Losses

For precision testing, wattmeter and voltmeter potential coil losses should be taken into account on all

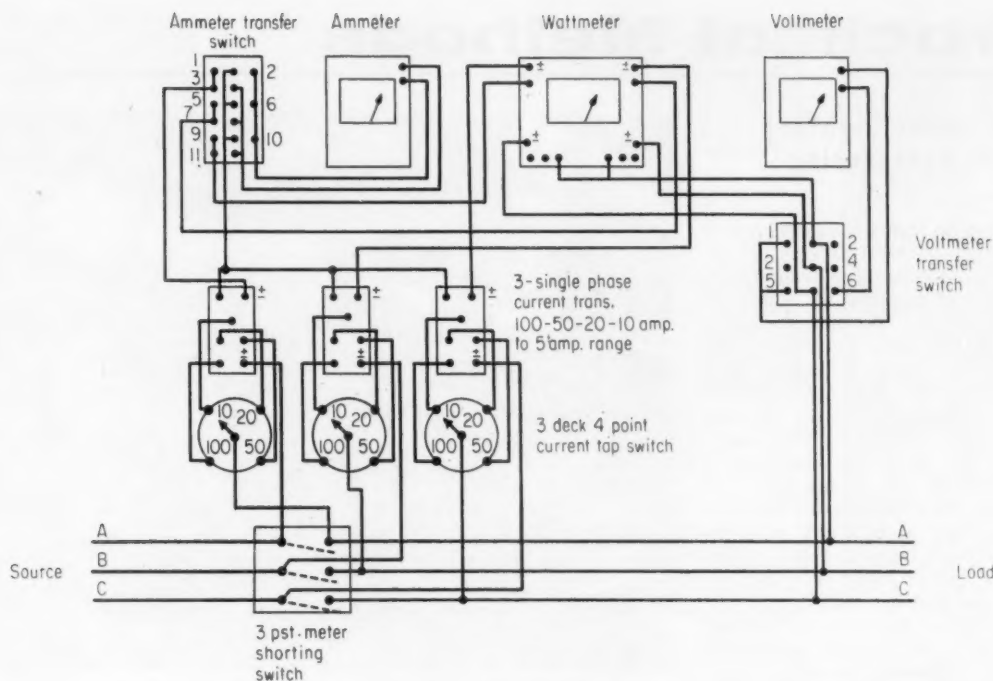


FIG. 6—Basic wiring diagram of the meter test table can be used to build any convenient layout. If desired, relay-controlled switches with pilot lamps can be added.

readings. To do this, set the current transformers on the lowest current ratio possible. Then, with no motor on the test lines, turn on the contactor and read watts on the wattmeter.

For example, suppose 440 volts applied to the line, with a current transformer ratio of X2, gives a wattmeter reading of 5 watts. Then, total watts loss would be X2 for the current transformer and X5 for the wattmeter, or a total multiplier of X10. In practice this would be slightly high but reasonably close to the true reading, depending on the quality of the instrument. Meter loss for each voltage (110, 220, 330, 440, 550, 660) should be ascertained, then deducted from the wattmeter reading after it is multiplied out.

The necessary components for this type of test stand are easy to obtain and install. The layout makes operation simple and efficient. The addition of facilities such as this will permit motor shops to test more motors in less time without more motors with greater efficiency in less time, improve the accuracy of the tests, and increase customer satisfaction without the need of additional personnel.



FIG. 7—Portable meter table with backboard automatic control panel. Meters can be covered when not in use. Table top provides adequate "desk" space to record meter readings.

Practical Methods

High-Level Lighting for Manufacturing

LIGHTING

A general lighting system which provides high level of comfortable working light ranging from 180 to 250 fc was selected to illuminate the 20,000 sq ft manufacturing area of the Erickson Tool Company's new plant in Solon, Ohio. The firm, which manufactures precision holding devices for machine tools and automatic machinery, moved into their new quarters in mid 1957. It was at this time that company officials designed the new lighting system that will take the place of the outdated system previously in use in their old plant.

The old lighting installation consisted of a series of overhead fluorescent units, plus additional fluorescent fixtures mounted above each machine, with supplementary incandescent units fastened to each individual machine. The lighting system in the new structure consists of 230 fluorescent fixtures with each unit containing two G. E. Power-Groove fluorescent lamps. These fixtures are arranged in continuous rows stationed 10 ft apart and located 10 ft above the floor to provide the overall area with 180 fc.

Supplementary lighting needed in the grinding department was supplied by mounting additional



HIGH-LEVEL comfortable working light provides precision grinding department of manufacturing area with a maintained lighting level of 250 fc. Installations such as this have proved that good lighting systems help to trim the high costs of doing business.

2-lamp fluorescent units crosswise between the regular fixture rows at 12-ft intervals, which increased the lighting level in this area to 250 fc.

The lighting system was originally designed to provide 160 fc of light in the general work area and 200 fc in the precision grinding area. But from the very beginning higher levels were realized,

and after 2,400 hours of operation, levels of 180 and 250 fc respectively are being maintained.

Company officials have stated that the new lighting installation has proven its worth many times over; in fact after six months of operation they made the following report which they attributed directly to the lighting in the plant: (1) Production increase of 10%,

EYE-CATCHING BILLBOARD in St. Paul, Minn., downtown business section is opening gun of Tieso Electric Co.'s outdoor advertising campaign. Boards like this, coupled with constant

newspaper ads and supplemented by radio and TV spots "serve as a constant reminder to the buying public that we are electrical contractors," Tieso management maintains.

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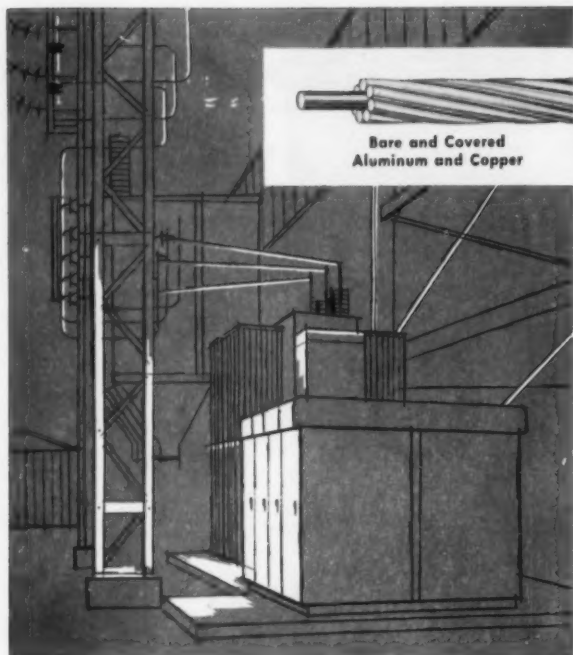


Thread Chasers

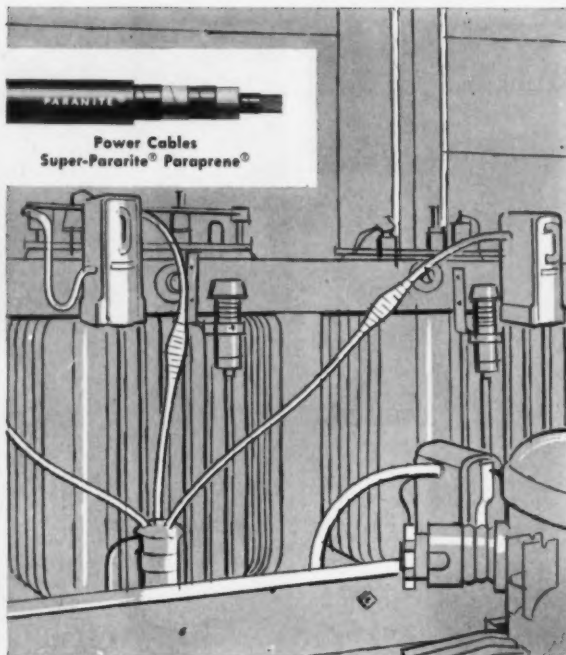


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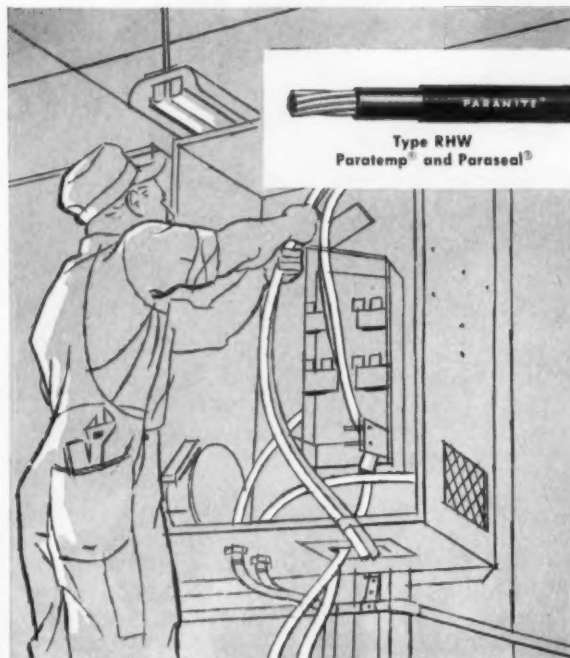


PARANITE WIRE AND CABLE DIVISION

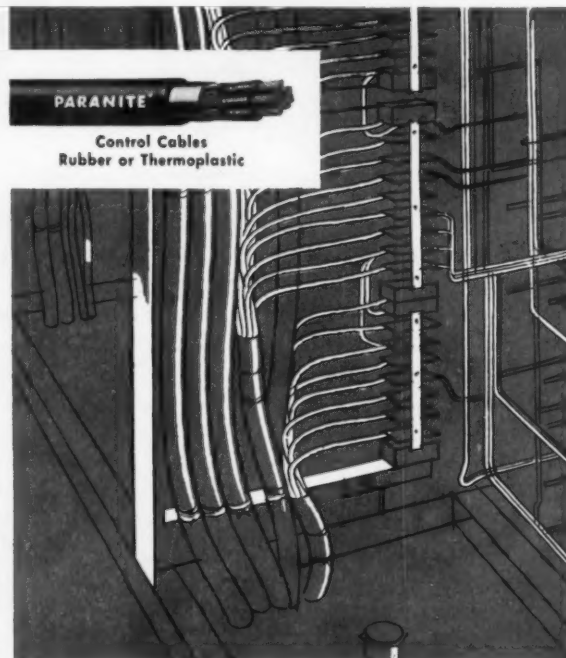
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even though many of the machine operators were newly hired. (2) 10% to 20% reduction in rejects in the grinding area where final finishing work is done under tolerances of .0001 of an inch. (3) Complete elimination of errors due to misreading micrometers. In the old plant, this type of error accounted for 4% to 6% of all rejects. (4) A 50% reduction in minor accidents. (5) Noticeable rise in worker morale. Worker complaints of headaches and eye fatigue due to lighting have completely disappeared. It was further realized that the savings afforded by eliminating lost time in adjusting and maintaining the supplementary lighting on each machine (which amounts to about ten minutes a day per man) would more than pay for the cost of power needed to operate the new Power-Groove system.

One other advantage which should also be noted is the complete flexibility of machinery placement because of the new overhead lighting installation. It is now possible for any or all machinery to be moved or relocated without having to rearrange the lighting.

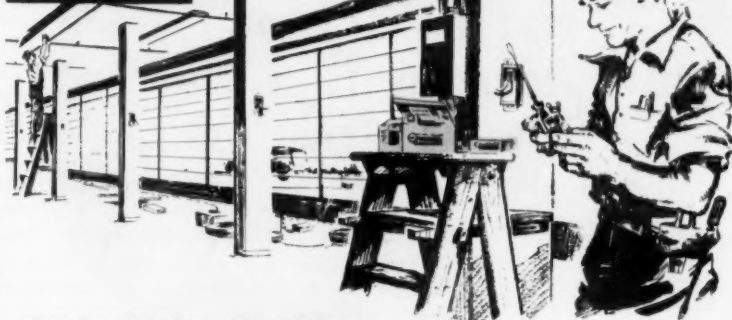
The high-level lighting program was also carried into the plant's office area and drafting room. The lighting system here delivers 125 fc in the offices and 250 fc in the drafting room.

As a final economy move the company has set up a group relamping and maintenance program, with all lamp replacement and cleaning being done at once. The relamping and cleaning will take place at the end of the first 18 months according to the present schedule.

Mechanized Method For Cable Burial

INSTALLATION

A mechanical "mole" with billy-goat abilities—that's the way Southern California Edison Company officials described equipment used to lay an underground electric power cable down the face of a steep mountain recently. The "mole" actually was a 40-ton tractor pulling a ripper blade. Using its bulldozer blade as an emergency brake and to clear brush, the tractor inched its way down a sheer ridge of Gorman Peak, near Los Angeles, negotiating grades of from 20 to 45 degrees to extend electrical service to a Civil Aeronautics Authority beacon.



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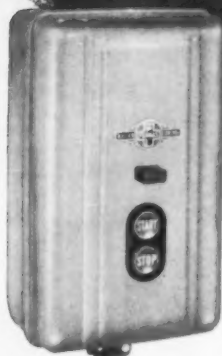
WIRING DEVICE OFFICE AND WAREHOUSE LOCATIONS

Bridgeport 2, Connecticut
State and Botwick Streets
Chicago 7, Illinois
37 South Sangamon Street
Los Angeles 12, California
103 North Santa Fe Avenue
San Francisco, California
1675 Hudson Avenue

IN CANADA:
Scarborough, Ontario
1160 Birchmount Road

CONTRACTORS

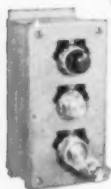
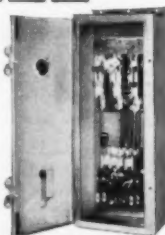
REDUCE COST AND
SPACE REQUIREMENTS
WITH FURNAS ELECTRIC CONTROLS



Furnas Electric offers the **RIGHT** control for every job. Enjoy cost and space advantages by choosing the control designed for the motor.

Only Furnas provides a choice of 10 starters through Size 4, instead of the usual 5, to match the applications from 1 hp to 100 hp. All are UL listed. Exclusive "in-between" sizes give additional cost and space advantages.

Combination Starters—a single mounting plate containing magnetic starter and disconnect for economical installation. Combination unit is used for all types of enclosures as well as an open unit for panel mounting. All Furnas Combination Starter enclosures feature external mounting feet for simplicity and accessibility.



Push Buttons for every need—Standard, Heavy-duty and Oil Tight. Choice of either front or back mounting. Furnas standardization and interchangeability mean more variations with fewer parts. Complete accessory line.



Drum Controllers



Pressure Switches



Limit Switches



Foot Switches

F - full information write for Catalog 5800,
1067 McKee St., Batavia, Illinois

A38



FURNAS ELECTRIC COMPANY
BATAVIA, ILLINOIS

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES



TRACTOR-RIPPER rig moves slowly down side of mountain—clearing brush, gouging trench for underground cable and laying the cable in the trench from the reel shown.

Southern California Edison has pioneered in this unusual method of underground cable laying, and the Gorman Peak operation was considered one of the steepest and most rugged ever attempted. The ripper has a long, narrow blade which rips a slot in the earth 4 ins. wide and 2 ft or more deep. Cable from a reel mounted on the tractor is fed into place at the bottom of the slot as the rig moves along.

Gorman Peak, located near the summit of California's famed Ridge Route (Highway 99), has an elevation of 4,908 ft and is vulnerable to wind, sleet and sometimes fire. It was because of these potential hazards that underground cable was decided upon.

Approximately 2,200 ft of 2-in., wire-armored cable was buried during the operation. E. A. Irish Co., contractors, did the job for Edison.

Portable-Adjustable Maintenance Lighting

MAINTENANCE

Maintenance of the vast electrical system is no simple matter at Garden State Plaza shopping center in Paramus, N. J. Here the system includes distribution at 26 kv and 12 kv for a load-center layout, circuiting at 480/277 volts and 120/208 volts and extensive and elaborate electrical control equipment. But Anthony Mazzei, chief electrician at G.S.P., fully measures up to the requirements of effective maintenance. One example of his preparation for efficient work procedure is the work light assembly which he fabricated for use in the main switchboard room.

As shown in the accompanying photo, this work light rig consists of eight 150-watt reflector-lamp spot lights mounted on a floor-standing mast. The eight lamps are

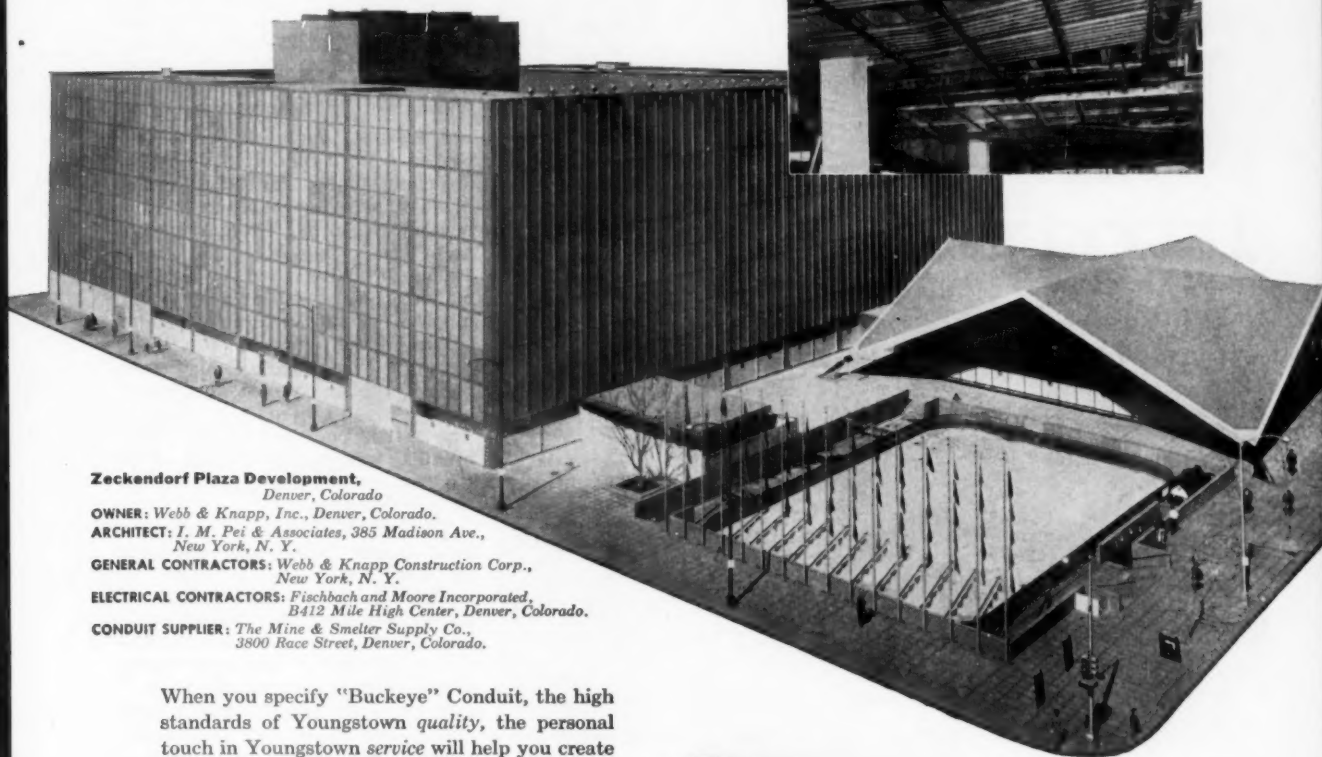
Accent on Excellence

Youngstown "Buckeye" steel conduit

This highly-functional modernistic department store building—only one of many new structures that will make up Denver's Zeckendorf Plaza Development—has built-in lifetime wiring protection, thanks to Youngstown "Buckeye" Full Weight Rigid Steel Conduit.

Damaging elements such as water, moisture, vapor, dust and dirt can never cause disruption of the building's all-important electrical system, because "Buckeye" Conduit will perform its protective function as long as the structure remains standing.

Installation of Youngstown "Buckeye" Conduit is shown during construction of the new May-D&F Department Store in Denver, Colorado.



Zeckendorf Plaza Development,

Denver, Colorado

OWNER: Webb & Knapp, Inc., Denver, Colorado.

ARCHITECT: J. M. Pei & Associates, 385 Madison Ave., New York, N. Y.

GENERAL CONTRACTORS: Webb & Knapp Construction Corp., New York, N. Y.

ELECTRICAL CONTRACTORS: Fischbach and Moore Incorporated, B412 Mile High Center, Denver, Colorado.

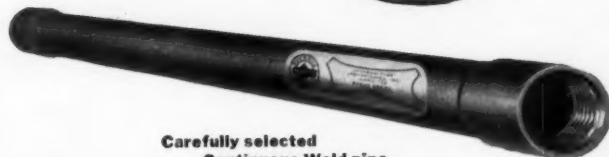
CONDUIT SUPPLIER: The Mine & Smelter Supply Co., 3800 Race Street, Denver, Colorado.

When you specify "Buckeye" Conduit, the high standards of Youngstown quality, the personal touch in Youngstown service will help you create electrical wiring systems with an "accent on excellence".



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YOUNGSTOWN
SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yaloy Steel
Youngstown, Ohio



Carefully selected Continuous Weld pipe

is first accurately threaded. Next, the pipe is thoroughly cleaned by pickling. Then it is immersed in a bath of molten pure zinc. A special process is used to remove it from this bath so that a clean, smooth zinc coating remains on both inside and outside. Then a coating of tough, transparent lacquer is baked on both inside and outside surfaces, providing a smooth raceway through which wires may be easily fished. This is Youngstown's long-lasting, trouble-free, easy-bending hot galvanized Buckeye Conduit.

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MILLIONS OF LAMPS A YEAR ...
ONE PLANT standard of quality control

TEST ... TEST ... TEST ... Continuous testing is one of the many ways Champion applies LIGHT-manship to make sure that every Champion Lamp is uniform in life and light output ... that you don't have to worry about early burn-outs and early dim-outs when you use Champion lamps.

Send for the New MAINTENANCE MANUAL, 48 pages of practical suggestions for making the most of your lighting system.

CHAMPION LAMP WORKS
Lynn, Massachusetts
A division of Consolidated Electric Lamp Co.



ANTHONY MAZZEI, chief electrician at Garden State Plaza, Paramus, N. J., here adjusts the height of the cluster of spot lights on this useful, portable work-light unit which he constructed for use in maintenance of the extensive electrical system.

clustered at top in swivel sockets tapped from a conduit fitting with sufficient hubs for the socket mounts and a removable back cover held on by screws. The bottom hub from the fitting is coupled to a standard switch box which is mounted on the end of a length of pipe. A switch in this box provides control of the lights. Supply to the lights is made by a 3-conductor, No. 16, rubber covered cord which has a ground-type plug on its end. The third conductor in the cable provides effective grounding of all non-current-carrying metal parts of the assembly.

The length of pipe on which the light cluster is mounted can slide up and down over a length of smaller diameter pipe which is tightened into the round floor stand. The section of pipe fixed to the base has a series of holes drilled through it at regular intervals along its length. The height of the lamp cluster can be adjusted by sliding the upper length of pipe up to the required height, then inserting a heavy, steel pin through the highest, exposed set of holes in the fixed section of pipe. The bottom edge of the upper section of pipe then rests on the cross pin. To provide quick and convenient use, a suitable steel pin is attached to the end of a length of chain connected to the base.

This assembly finds wide and varied use in electrical maintenance work. It is ideal for providing high lighting intensities on work being done in the normally

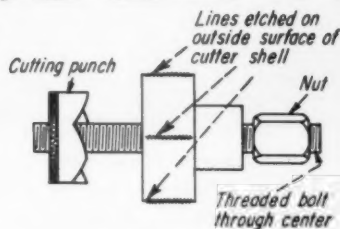
dark interiors of switchgear cubicles. And wherever floor-standing equipment blocks light provided by the ceiling luminaires, this portable unit can be moved in quickly. And in cases where the level of light provided by the general lighting fixtures is insufficient for close, detailed work or very important work, this unit will provide the necessary intensity. These applications are everyday occurrences at G.S.P.

Aligning Holes in Electrical Cabinets

INSTALLATION

A simple method can be used to assure perfect alignment of conduit holes made with a knockout punch in electrical cabinets. This method eliminates the hazard of the bolt of the punch "walking" to one side or another.

As shown in the sketch, the conduit holes should be marked on the work when laying out the pattern.



TYPICAL KNOCKOUT PUNCH

The center punch prick for each hole should be marked at right angles with a square, using soapstone or crayon that is readily legible. Next the hole is drilled for the knockout punch bolt.

Before the large cutter is put on the bolt, it should be marked with lines on its outside surface at 0, 90, 180 and 270 degrees on its circumference. These lines should be acid etched on the surface parallel with the center line of the cutter.

Now the cutter can be placed on the bolt; the bolt passed through the hole; and the cutting punch tightened on the bolt. Then by lining up the marks on the cutter with the right angle lines on the hole pattern, the hole can be punched on the exact center marked for the hole.



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NEW AMP PROBE RS-3

Pyramid Instrument Corporation, Lynbrook, N. Y.
In Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto

Day-Brite Mobilex® fixtures are stronger with body and reflector combined into a one-piece unit... lighter for faster, safer installation... and thinner to allow greater freedom of placement.



A total of 181 Day-Brite MOBILEX units, each equipped with three 4-foot Rapid Start lamps, furnish 135 footcandles throughout 7,581 sq. ft. in the Accounting Department of the San Diego Gas & Electric Co. H. LOUIS BODMER, AIA, Architect; J. S. HAMEL, Electrical Engineer; A. W. MYERS ELECTRICAL CO., INC., Electrical Contractor; F. E. YOUNG CONSTRUCTION CO., General Contractor.

How lighting by Day-Brite does double duty

FOR THE SAN DIEGO GAS & ELECTRIC CO.... Day-Brite fixtures provide high-level illumination for easier, faster seeing. By making the company's offices a "lighting showcase," they also serve as a sales aid... show customers and visitors how much good lighting practices and beautiful fixtures can contribute to office appearance and efficiency.

FOR CONTRACTORS... Day-Brite fixtures work in these two important

ways: (1) Designed to go up faster, they save time on the job... help control costs. (2) Day-Brite design and quality make for a better looking job and better lighting performance... help to promote repeat business through *customer satisfaction*.

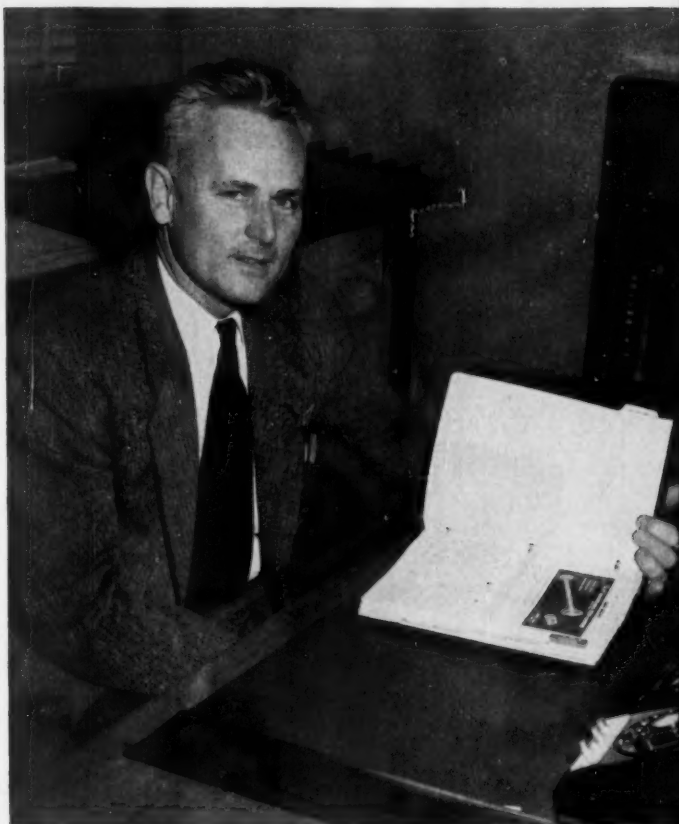
Find out all the many ways Day-Brite can work for you. Call your Day-Brite representative listed in the Yellow Pages.

Working with high-speed electronic business machines involves critical seeing tasks. That's why Day-Brite HOLIDAY® fixtures, with Controlens® enclosures, were specified.

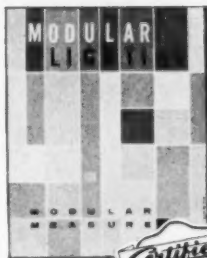
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DAY-BRITE...the Contractor's Choice



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ILLUSTRATED BOOKLET
ON DAY-BRITE
MOBILEX® AND
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Day-Brite Lighting, Inc.
6248 N. Broadway, St. Louis 15, Mo.
Day-Brite Lighting, Inc., of Calif.
530 Martin Ave., Santa Clara, Calif.

Z-332 © 1958

"Day-Brite helps us build our business"

... says A. W. MYERS
A. W. Myers Electrical Co., Inc.
San Diego, California

"Day-Brite makes it easier for us to be good businessmen. When we install a Day-Brite job, the customer's happy... and so are we.

"Take installation, for example. Everything needed to install Day-Brite fixtures is there when you need it... packaged to arrive on the job in perfect condition. Less time is lost in unwrapping and assembling miscellaneous parts.

"We're especially partial to Day-Brite hangers. They are the easiest to use... and have an adjustment feature that's second to none in the industry.

"Day-Brite helps us do a better job... helps us build our business on the strongest possible foundation: quality workmanship."

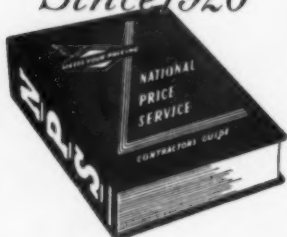
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What is a FAIR

PRICE?

To be **FAIR**, both
your customer and
you must profit.

Since 1926



NATIONAL PRICE SERVICE

suggests fair resale
prices for electrical
materials and tells
you what they cost
from day to day.

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Be FAIR to yourself.

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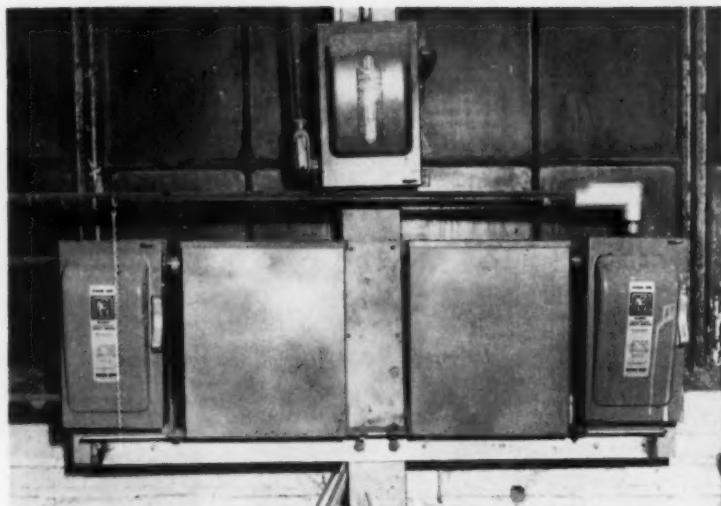
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Capacitors Pay Off In 18 Months

EQUIPMENT

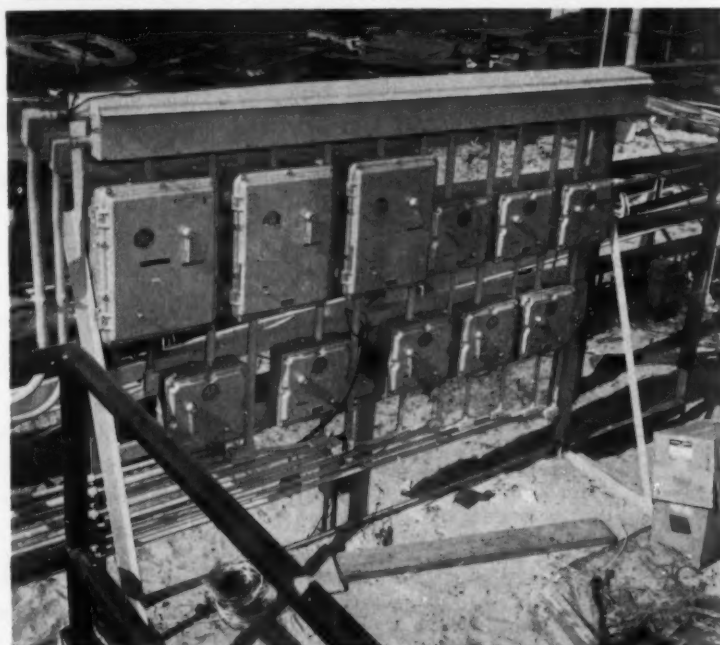
At the Wakefield Company plant in Vermilion, Ohio, an installation of two additional 15-kva capacitors produced savings of \$26.30 a month on the average, which is expected to pay for the equipment and installation in approximately 18 months, according to Carl A. Schroeder, factory superintendent.

The two capacitors were installed in November 1956 to improve power factor. As of December 1957, with one year's power bills available for

appraisal, the results were as follows:

Average saving per month	\$26.30
Annual rate of saving	\$315.60
Cost of capacitor installation	467.23
Estimated time to pay out, months	17 1/2

Before the change, power factor averaged 95.5% over 12 months. After the installation of the additional capacitors, the power factor averaged 99.2%.



OUTDOOR CONTROL PANEL in the pulp yard of a midwest paper plant provides centralized manual control of motors on log conveyors and de-barking equipment. Sturdy channel-iron frame supports groups of weatherproof starters nipped to metal wiring trough at top.



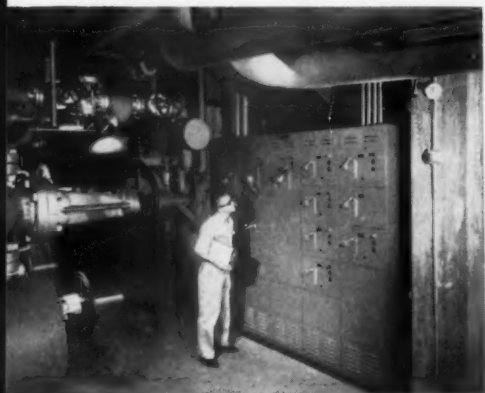
Cardinal Glennon Memorial Hospital for Children, St. Louis, Mo., occupies 4½ acres, employed 4,000,000 man-hours of labor in a three-year construction period.

One of two Westinghouse motor control centers with Type B wiring installed in hospital. Each starter has 480- to 110-volt individual control transformer for controlled circuit.

J-94111-1

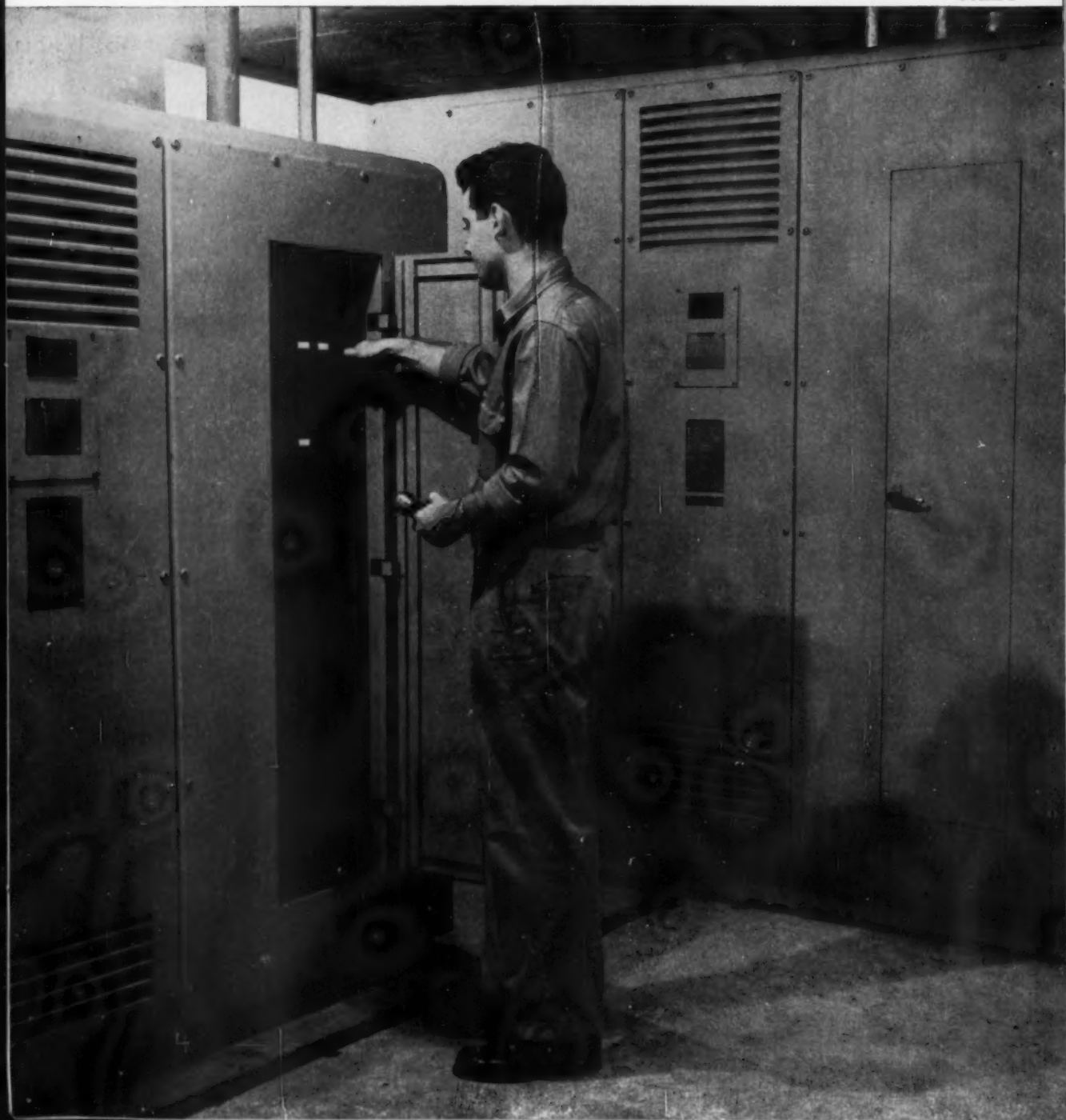
Fail-proof electrical system
for children's hospital
supplied by Westinghouse

YOU CAN BE SURE...IF IT'S Westinghouse 



All-Westinghouse electrical distribution system
was unanimous choice for long-term service

J-94111-2



Hospital conference room scene includes Norman H. Maas, Electrical Engineer for Maguolo and Quick, Architect; Joseph F. Dwyer, Manager of Hospital's Central Office and Coordinator of Building Committee; Sister Mary Vivian, S.S.M., Director of Occupational Therapy; Louis S. Sachs, S. C. Sachs Co., Inc., Electrical Contractor; (standing) W. L. Phiffer, Westinghouse Construction Sales Engineer; Paul Olchner, Westinghouse Area Sales Manager; and Walter R. Riechman, Westinghouse Electric Supply Co.



Selection of all-Westinghouse equipment for the electrical distribution system of the Cardinal Glennon Memorial Hospital for Children was made only after the many exacting requirements for hospital service were established and analyzed. The success with which the requirements are being met is shown in the quotes which follow:

The hospital manager reports, "During the 1½ years we have been in operation, the electrical distribution system has required no maintenance other than a periodic check by Westinghouse engineers. Inasmuch as this equipment was furnished by one manufacturer, we have the advantage of undivided responsibility along with a minimum parts inventory stock."

The electrical contractor adds, "The extensive cooperation by Westinghouse in scheduling shipments and in arranging larger shipments to facilitate handling provided us with the optimum flexibility we needed for the three-year construction period."

(continued)

YOU CAN BE SURE... IF IT'S **Westinghouse** 

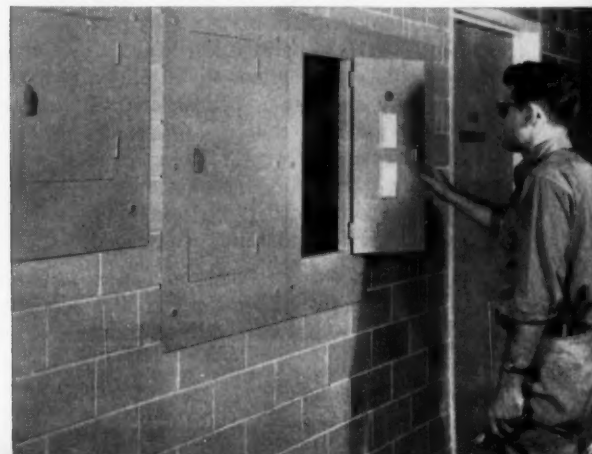


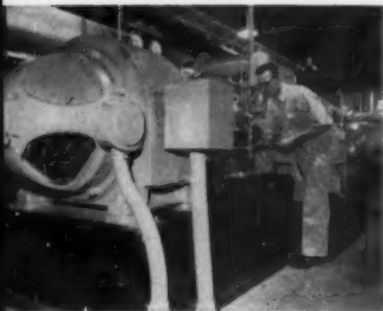
Engineers and contractors discuss Westinghouse metal-clad 5-kv indoor switchgear employing preferred-emergency incoming line transfer arrangement.

Westinghouse Type NLAB Quicklag® breaker lighting panelboards. A total of 42 lighting panelboards and 10 power distribution panelboards are installed in hospital.

Transformer room close-up shows three of hospital's five Westinghouse dry-type self-contained power centers. 75-kva 208-volt wye to 120-volt delta ungrounded insulating power center is in foreground, and two 225-kva power centers are at rear.

J-94111-3

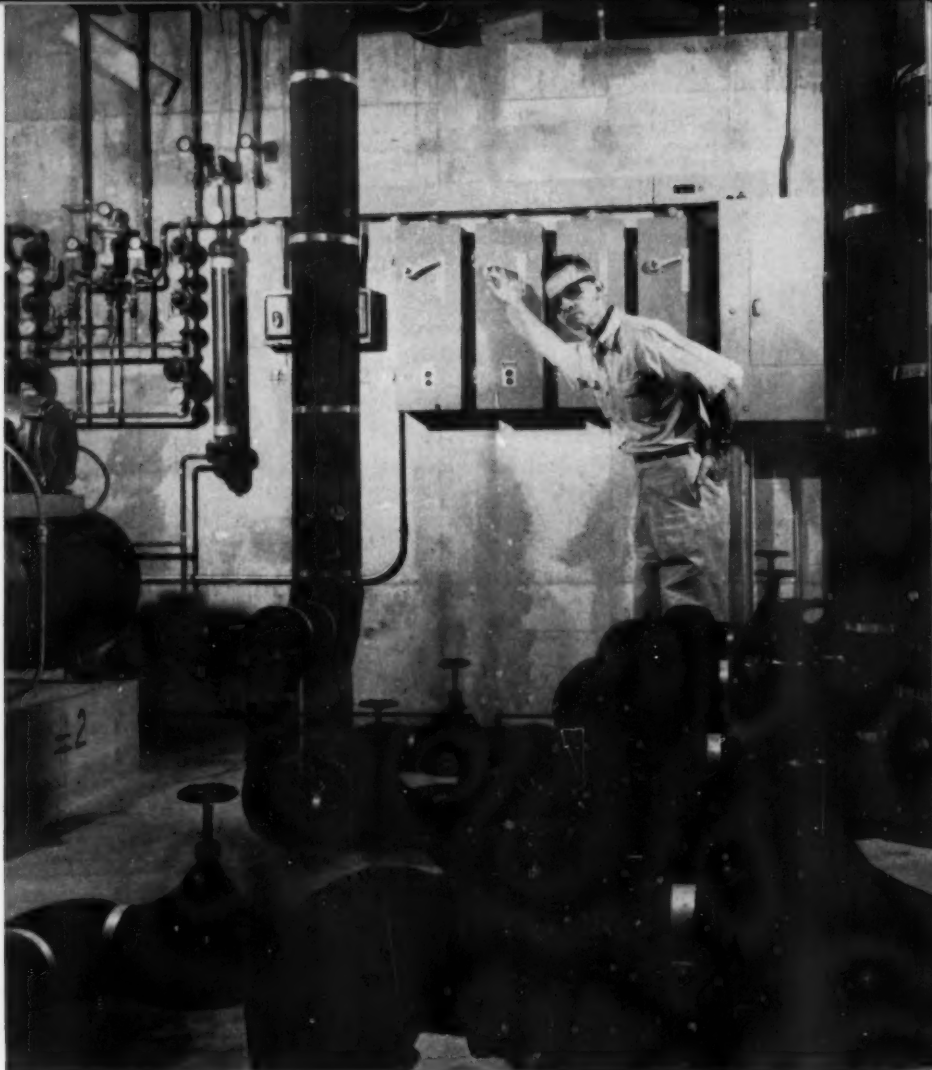




View of components in air conditioning compressor hook-up. In foreground is a Westinghouse 250-hp wound-rotor induction motor with Type SU double-helical-type speed increaser—1760 to 6750 rpm.



The Cardinal Glennon Memorial Hospital cares for children between the ages of one to twelve, regardless of race, color or creed.



Individual protection of vacuum pumps is provided by Westinghouse Class 11-204, Size 1 starters in NEMA 1 enclosures.

All-Westinghouse system unanimous choice for long-term service *(continued)*

The architect-engineering firm, reviewing the design and engineering which went into the hospital, says, "Our design criteria for the building was established at 100 years, and we selected all material and equipment on that basis. Because of the critical demand for absolute reliability on the electrical system in a hospital of this type, our first consideration was the duplicate primary service, with each 5000-volt feeder from a separate substation as a power failure safety factor. Our past experience with Westinghouse in working out this particular kind of transfer system in conjunction with their application engineers gave us the proved dependability we needed."


Details of some of the Westinghouse equipment used in the Cardinal Glennon Hospital are illustrated on these pages. Additional information

about how Westinghouse helped meet the electrical needs of this hospital is available. Information is also offered in helping you solve your own electrical requirements. See the Westinghouse electrical construction engineer nearest you or write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania.

Cardinal Glennon Memorial Hospital for Children
Architect-Engineer: Maguolo and Quick
Electrical Contractor: S. C. Sachs Company, Inc.
General Contractor: John B. Gutman Construction Company
Westinghouse Distributor: Westinghouse Electric Supply Company

J-94111-4

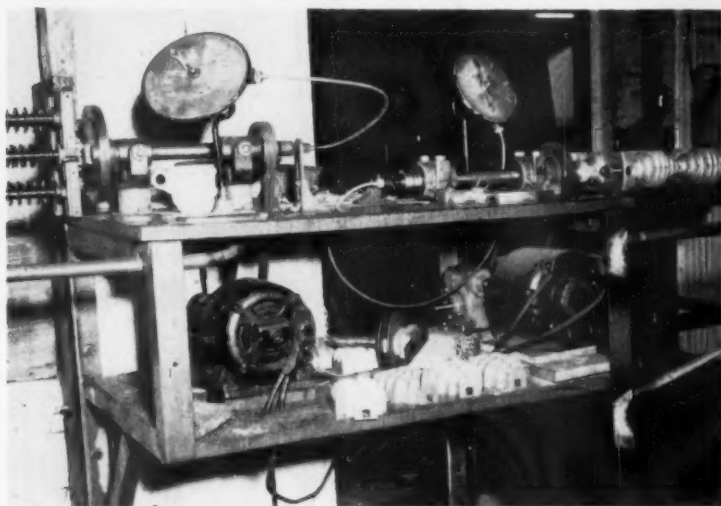
YOU CAN BE **SURE**...IF IT'S

Westinghouse 



Over 250 Pages
 Westinghouse Data
 in Sweet's Construction File

Motor Shops



SIMPLE IN CONSTRUCTION, these winding assemblies have performed satisfactorily for many years, proving that useful methods and devices need not be elaborate.

Shop-Made Winders Are Practical Tools

Compact convenience is obtained in the coil winding department of Lange Electric in Baltimore by mounting two winding rigs, together with drive motors, gear boxes and accessory components, on a single work bench. As indicated, winders and flex-connected counting devices are mounted side by side, while the related fractional motors and geared reduction assemblies are located on the shelf below. Both rigs are controlled by foot pedal, thereby leaving operators' hands free for other purposes.

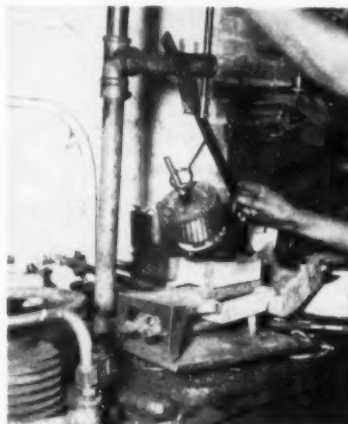
Soldering Rig Promotes Smooth Application

Getting an even, smooth coating of solder over the commutator end of a small rotor can be facilitated by using a rig similar to one used by Lange Electric of Baltimore.

This rig basically consists of a pipe upright, secured to the work bench adjacent to a gas-fired solder pot. From this vertical upright a horizontal arm extends out over the pot, and through the end of the extension runs a vertical threaded shaft which may be raised or lowered by action of a wheel located at its upper end. The bottom of the shaft holds a flat steel bar which is equipped at its bottom end with a

small cup or pocket, and which is drilled in numerous places to permit either shifting the shaft pivot bolt or to receive the hook end of a ring hanger, as indicated in the photo.

As noted, the flat bar can be regulated in height by the threaded shaft and can be inclined as desired by hand action. Also as noted, the shaft of the rotor is held by the cup at the bottom and by the ring hanger at the top. These several adjustments and attachments then make it possible to lower the commutator to an exact level and position. Then, by rotating the unit, solder can be applied with uniform thickness and smoothness.



POSITIONING of small rotor above a solder pot is facilitated by this rig constructed from pipe sections and accessories, a screw shaft and bar hanger.

Largest 2-Pole Motors Are Class H Insulated

Four 2-pole induction motors, built by the Elliot Co. for Consolidated Edison of New York to drive boiler feed pumps and rated at 6000 hp, 3600 rpm, 4160 volts, are the largest silicone-insulated motors ever built.

Coils are composed of silicone-treated, double-glass-covered magnet wire. Before each coil is formed, the conductor groups are wrapped with silicone-bonded, glass-backed, mica tape.

The main insulation embodies Silastic (Dow Corning) products throughout, the builders report. By specially developed techniques, such materials as silicone rubber glass reinforcing tapes, Silastic pastes,



STATOR of 6000 hp, 3600 rpm, boiler feed pump motor has complete 180 deg. C (Class H) insulation system.

and compounds and varnishes are carefully processed on the coils to provide an insulation system of 180 deg. C (Class H) rating. Every material used, including silicone-bonded glass laminate and silicone-treated glass cord in the end winding support and bracing, has this thermal capacity.

Stators Removed with Use of Pin Plates and Collars

Wesley Jagger of Wilmington, Del., has constructed an assortment of pin plates and collars that assure fast, careful removal of stators from housings without damage to either. Collars, of various diameters, have "inner shoulders" that support various sizes of motor housings. Pin plates consist of circular steel plates equipped with threaded pins that align with end-



Threads Cost Less...

with New

RIDGID

that stops oil waste!

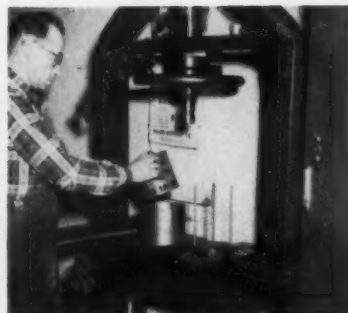
Costs Only
\$23.20
with 2 gallons of
RIDGID

Pays for itself quickly 3 ways;

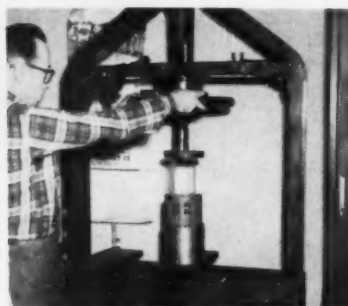
- Costly oil is screened and re-used—no waste, no messy floors
- Well oiled dies last longer . . . give cleaner, sharper threads
- Sharp, clean-cut threads mean fast, easy installations.

Check the Specs: Screened chip pan traps metal scraps, cleans oil for re-use. Flexible hose carries oil from reservoir to easily operated pump-gun. Snap latches and rubber gasket seal chip pan to reservoir for easy splash-proof carrying. Use it once and you'll wonder how you ever got along without it. See it at your Supply House!

The Ridge Tool Company • Elyria, Ohio, U.S.A.



WITH COLLAR IN POSITION beneath the yoke press, a motor stator is placed on the collar's inner shoulder; a variety of such collars being stocked for this purpose. Then the . . .



PINS OF THE TOP PLATE are aligned with and inserted into the corresponding end-bell bolt holes; the press is spun down and the downward thrust evenly removes the stator.

bell bolt holes in various sizes and types of stator frames.

As pictured, collars are positioned directly beneath the yoke press, the motor housing is placed in position on the collar shoulder, the pins of the top plate are inserted into stator bolt-holes, the press shaft is lowered by means of spinning the hand wheel, and the stator is forced out of the housing easily, evenly and quickly.

This routine job now takes only a few minutes, whereas, prior to the construction of these simple shop "tools", the time element was considerably longer and the possibility of damage was a recurrent problem.

Portable Flamethrower For Rewind Work

Ship's Electric Service motor repair shop in New Orleans makes much use of a portable flamethrower for burning out motors for rewind. This piece of equipment can be moved anywhere in the shop to meet normal variation in space available for small motor burnout. It can be set up readily and pro-



EDMUND FEDERER, foreman in the modern motor repair shop at Ship's Electric Service, is starting up the portable flame-thrower for burning out a small motor to be rewound.

vides fast, effective loosening of windings for easy stripping as the first step in a rewind job.

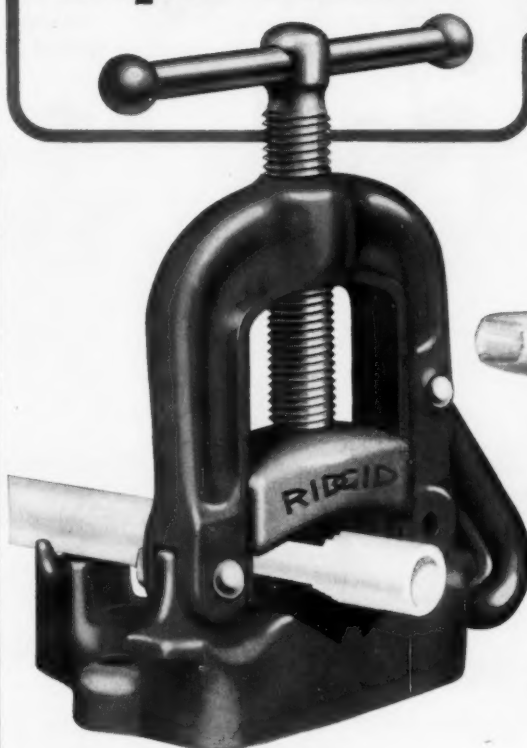
In the photo above, Edmund Federer, capable foreman in this shop which specializes in marine work, demonstrates the flame-thrower in action. A gas hose is attached to the fitting on the back end of the horizontal length of pipe. An air hose from the shop's compressor is also attached to this fitting. Each input on the fitting has a valve to adjust the amount of input. The front end of this piece of pipe is equipped with a torch nozzle to provide proper play of the flame output. The horizontal gun piece is supported in an adjustable clamp on top of the upright length of pipe. This affords proper positioning for different heights and different angles of flame play. The vertical pipe is attached to a bracket piece mounted on an old automobile brake drum.

To use the flamethrower, the gas is first turned on and ignited. Then the air pressure is adjusted to provide the required jet flame. The equipment to be burned loose is set on a small steel table directly in the flame.

Wire Wheels Used To Strip Small Coils

John Lange, owner of the Baltimore motor shop that bears his name, claims that coil ends of small armatures can be stripped off quickly by using a pair of wire brushes which are geared to revolve in opposite directions. As noted in the photo, the brush spindles proceed through a steel bed plate which is bolted to the

More Than Just a Pipe Vise



Yoke or Chain Vises
1/4" to 6" capacities
Bench, Stand, Post
or Kit

RIDGID

**Pipe Vises give you
most utility for your money**

RIDGID LonGrip jaws take a firmer grip on conduit—and without chewing it up. Most of these vises have handy work-tray bases, conduit rests and benders, doing more for you than merely holding conduit. It pays you to ask for **RIDGID** at your Supply House.

The Ridge Tool Company • Hyris, Ohio • U.S.A.



Panelboard planning helps

The special requirements inherent in modern hospital function make design and selection of the proper components to POWER-UP the electrical system far more exacting than for many other applications.

One example of careful electrical planning is the United States Naval Hospital addition at San

Power-up San Diego Naval Hospital

Diego, California, where Westinghouse Panelboards were specified to serve as the vital nerve centers of the hospital electrical distribution system.

In addition to several Westinghouse switchboards, a total of seven Westinghouse type CDP power distribution panelboards and 64 type NA1B

lighting panelboards were installed in the new 1000-bed addition to the naval hospital.

Find out how Westinghouse Panelboards can help you POWER-UP for greater profits; contact your nearby Westinghouse office, or write: Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania.

J-93544

United States Naval Hospital, San Diego, California

ARCHITECT-ENGINEERS: Welton Becket and Associates, Los Angeles, California

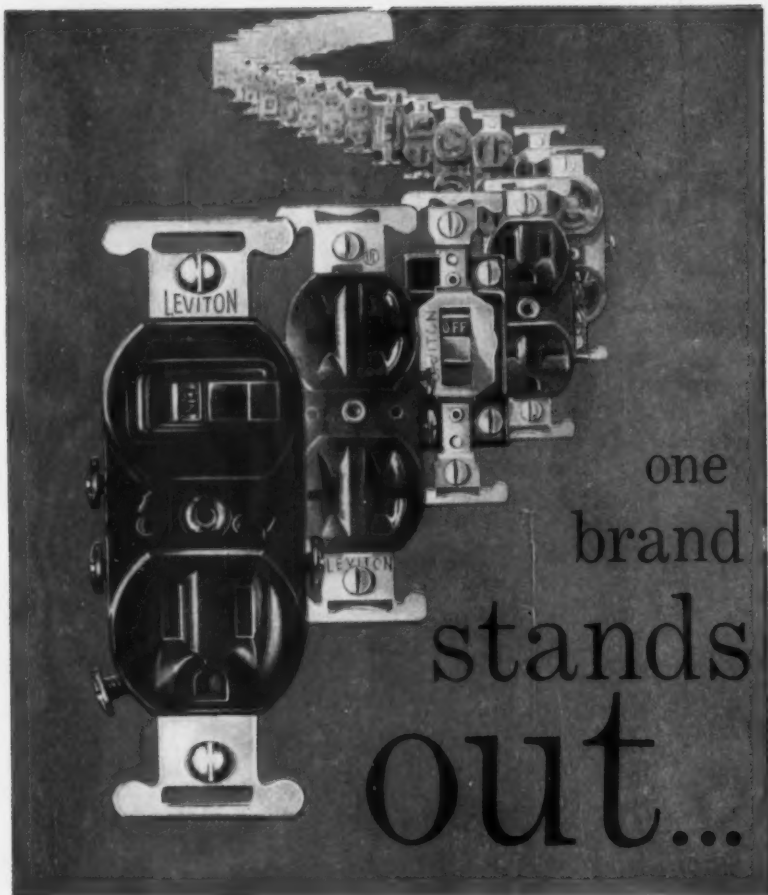
GENERAL CONTRACTOR: George A. Fuller, Dallas, Texas

Hospital electrician examines Westinghouse NA1B Panelboard on corridor wall. Each of these 64 panelboards controls 40 different hospital lighting circuits.



Architect Engineers: Welton Becket and Associates

YOU CAN BE SURE...IF IT'S Westinghouse



LEVITON *specification grade* Switches and Receptacles

Compare Leviton wiring devices under any conditions . . . Leviton gives you the utmost in performance at minimum cost . . . with absolutely no compromise in quality.

SPECIFICATION GRADE INCLUDES

*The Complete
"5000" Line*
Combination Line
Lev-O-lock Line
Quickwire Line
U-grounding Devices
Interchangeable Devices
Lev-O-let Line

CHECK THESE TYPICAL FEATURES

- Heavily sectioned molded phenolic bases.
- Full gauge straps, completely rust proofed and riveted to assemblies.
- Plaster ears — wide and break-off types.
- Terminal screws with large heads to accommodate No. 10 conductors and backed out for quick wiring.
- Individually packed with mounting screws attached to straps.
- All switch mechanisms utilize high grade bronze for wide, double wiping contacts.
- Assemblies riveted for permanence.
- All power outlets have double-wiping phosphor bronze contacts.
- Meet U.L., C.S.A. and Federal Specifications.

Samples on Request



LEVITON MANUFACTURING COMPANY
BROOKLYN 22, N. Y.

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For building wire and cable contact our subsidiary: AMERICAN INSULATED WIRE CORP.



ARMATURE is moved against geared wire brushes as speed of spindles is regulated by small motor and foot pedal control.

work bench. Rotation is provided by a fractional motor mounted beneath the bench, and operation is governed by a foot-pedal control switch.

Operation by foot pedal leaves both hands free to position the armature-supporting cradle and move it towards or away from the brushes as the armature is rotated and the motor coils are progressively severed. Cradle construction is simple, consisting of a U-shaped frame constructed from 2-by-4 blocks which are notched, as indicated, to receive both ends of the armature shaft.



TWO NEW OFFICERS were added to the managing staff of Kufen Electric, Hatboro, Pa., at the time of that company's recent incorporation. These men, George G. McDaniels (left) and Julius J. Kosenski, hold the respective titles of secretary-treasurer and vice president. At the same time, welding and machine shop operations were also added to round out the full-scope service facilities of this organization.

Why He's Getting **MORE** Than a Motor



He's getting answers to motor problems the easy way *with the Century Electric Motor Application Guide*

Want a quick, easy way to get answers on motor applications? This easy to follow Century Electric motor application guide will help you do just that. Here's how you can make it work for you.

Suppose you need a motor to drive a fan. Knowing your power supply (a-c or d-c) you look on the chart on page 2 for the motor whose characteristics match the load you want to drive. Having done this it's easy to check the mechanical variations (page 8) to find the enclosure you need—depending on whether it is operating in an explosive, moist, etc. atmosphere. Then you have type, dimensions and operating characteristics, all at your fingertips.

Of course, this is good for simple routine applications. If your problem is more complicated, your Century Electric sales engineer will be glad to help. He can sit down with you and offer on-the-spot advice or if necessary get more complete data—drawing and models for you.

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Beaver
Speed-O-Matic
Equipped with
Electrimatic
Chuck

Electrimatic Chuck
Operating Panel

New Beaver
Electrimatic Chuck
(Patent Pending)

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with the ORIGINAL "Electrimatic" Chuck

**GUARANTEED TO GIVE YOU THE
MOST PRODUCTION AT LOWER COST!**

Completely eliminates manual chucking! Grips forward or reverse—the instant you flip the switch. Trouble free! The last word in operating simplicity! Precision built! Adjustable for "tight or light" grip, for hard or soft material. ($\frac{1}{8}$ " to 2" pipe or rods.) Available on the fast and famous, rugged, lightweight Beaver Speed-O-Matic or the super-fast, powerful and rugged, production-packed Beaver Model A.

You must have tops in performance and production to survive in today's competitive market. So, Buy Beaver — Now.



See your Beaver distributor today,
or write Beaver direct!

Beaver Pipe Tools, Inc.
279-500 Dana Ave. • Warren, Ohio



CONSTANT CHECKING of repair-work status, and pitching in to personally help out when jobs start piling up, is the policy of Joshua L. Bischell, president of the Electric Motor Service Co., of Baltimore, Md., snapped above during one of his frequent tours of his several work areas.

Ring of Flame Burns Insulation

A combination of a circular gas-burning ring plus a series of metal discs facilitates the charring and loosening of rotor windings prior to stripping by Lange Electric in Baltimore. The gas ring, as shown, has a diameter of 10 ins.; has a series of perforations on the inner periphery so as to direct flames inwards to the coils; and is positioned about a foot above the top of the work bench. The series of discs is used to obtain the exact height requirements, for these discs can be piled up or removed as desired. As indicated, the rotor shaft is inserted through the common centers of the discs, thereby remaining in a vertical position.



PILE OF DISCS regulates height of rotor-holding arrangement, while perforated pipe directs gas flames inwards to windings being burned prior to stripping.

We'll Prove It!



Square D Vertical Action Magnetic Starters Sizes 0, 1, 2, 3, 4 and 5

ONLY SQUARE D GIVES YOU ALL 5

1 **QUICK INSTALLATION!**

No groping or fumbling. Square D gives you lots of wiring space, plenty of knockouts, handy and clearly marked pressure wire connectors.

2 **TOP PERFORMANCE!**

No needless downtime from coil burnout, mechanical binding, contact freezing. Square D gives you an extra-capacity magnet with a tough and cool-operating encapsulated coil to handle additional poles and interlocks—a guided single moving part—big silver cadmium-oxide contacts with strong finger springs—arcing yokes on larger sizes.

3 **REAL OVERLOAD PROTECTION!**

No change in trip characteristics because of mismatched parts supplied separately for field assembly, no distortion of heater in installation. Square D gives you melting alloy unit construction—factory-assembled and individually tested for bull's-eye accuracy. Also bi-metal and magnetic designs for automatic reset or adjustable trip applications.

4 **EASY INSPECTION and MAINTENANCE!**

No starter is "maintenance-free." But Square D makes the job easy. Inspection is a breeze. You don't have to remove wiring for contact replacement or take the starter out of the enclosure to change coils.

5 **WIDE-RANGE ADAPTABILITY!**

No need for excessive inventories to avoid costly waiting for non-standard arrangements. Square D provides "off-the-shelf" kits for changing contacts and coils, adding pushbuttons, selector switches, and up to 4 double-throw auxiliary circuits.

Send for the COMPLETE Story!

Square D Company, Dept. 32,
4041 North Richards Street, Milwaukee 12, Wisconsin

Please send me your new bulletin with detailed proof that Square D offers me my best starter investment.

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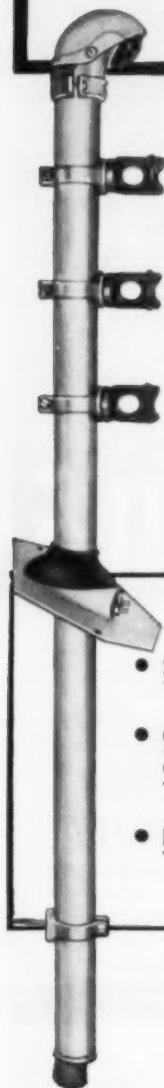
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CAREY, OHIO

Electric Heat . . .

The User's Viewpoint

Extensive survey points up the electrical contractor's role in a rapidly growing market.

A RECENT survey made by Berko Electric Mfg. Co. among buyers of electric heating panels furnishes interesting data which can be put to profitable use by the electrical contractor in selling electric heat. Following are the significant results, together with applicable charts and customer comments.

(1) *Users are better than 90% satisfied.* Table 1 summarizes questionnaire data and shows by states the results of the queries: "Are you satisfied with the heaters?" and "Would you recommend them to your friends?" Without doubt, people who buy electric heat like it—and without respect to degree-days. Some of the coldest states show highest acceptance.

(2) *There is unlimited sales potential in supplementary and auxiliary heat.* Chart 1 indicates that most of the units were used in the main rooms of the house, but Table 2 lists the many other locations for which customers found supplement-

ary electric heat the perfect answer.

Interesting comments were received describing auxiliary applications where electric panels were used to provide additional heat needed because of the inadequacy of the existing central system:

"It was just the answer for our dining room in a cold corner under a window, north side, back of my chair."

"We needed extra heat for our bedroom, which was at the end of the steam line."

A little imagination on the part of the contractor will suggest additional applications. While single-room installations comprise the major market today, they provide an excellent means of introducing the advantages of electric heat to sell the customer on complete house heating at a later date:

"My family enjoys the comfort and cleanliness of the panels so much that we plan to install them throughout the house as soon as possible."

TABLE 1: Customer Acceptance

State*	Number of Replies	% Satisfied with Heaters	% Willing to Recommend Heaters
Washington	875	90.6	88.2
New York	414	91.8	88.9
Oregon	386	91.4	90.7
New Jersey	145	93.8	92.7
Pennsylvania	74	93.0	90.2
Florida	64	87.0	91.1
Michigan	60	94.5	98.0
Virginia	51	100.0	100.0
Connecticut	48	97.7	95.5
Indiana	46	93.0	95.2
Maryland	44	93.0	92.4
Ohio	40	90.0	94.5
North Carolina	36	97.2	94.4
Montana	36	94.0	93.8
Minnesota	35	93.7	93.7
California	35	100.0	100.0

* Only those states with 30 or more replies are listed.

Total number of questionnaires delivered: 5944

Total replies received: 2573

Percent response: 43.3%

Satisfied: Yes 2227

No 203
91.8%

Willing to Yes 2157

Recommend: No 220
90.9%



New Space-Saving 1" Double Pole Breaker Adds Flexibility to Cutler-Hammer Unit Breaker Load Centers

Here's important news for you and your customers. New space-saving Cutler-Hammer double pole breakers provide a low cost means for expanding household circuit facilities without installing additional branch circuit units. These new breakers require $\frac{1}{2}$ less bus space which means wherever, within their ratings, two double pole breakers are presently installed you can now provide your customer with three double pole circuits. Also, if a homeowner wants an additional lighting circuit, you can replace a present double pole breaker with one of the new space-saving double pole breakers and a single pole breaker. You only pay for the new breakers . . . no new cases or costly installation effort needed.

The new Cutler-Hammer double pole breakers are

available in 15, 20, and 30 ampere ratings; and can be installed in any Cutler-Hammer Unit Breaker Load Center without special adapters or case modifications. See your nearby Authorized Cutler-Hammer Distributor and learn how you can serve your customers to a better electrical future with dependable Cutler-Hammer Service Entrance Equipment. CUTLER-HAMMER Inc., 1306 St. Paul Avenue,* Milwaukee 1, Wisconsin.



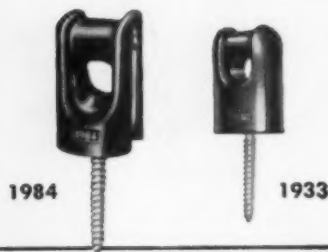
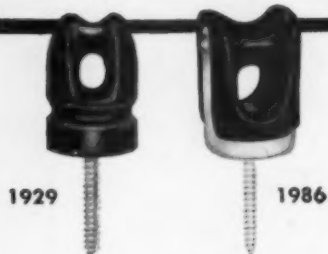
IT PAYS TO USE CUTLER-HAMMER CONTROL . . . NATIONALLY ADVERTISED . . . NATIONALLY RECOGNIZED

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JULY, 1958

123

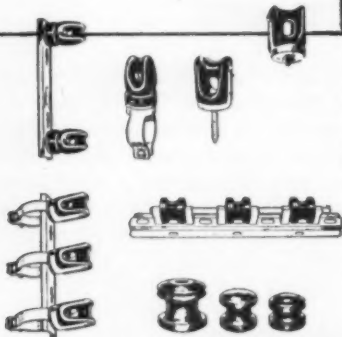
PORCELAIN PRODUCTS—

*the most complete,
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of Porcelain*



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*A complete, quality line of
secondary service materials*



64
years

Electrical Porcelain
Since 1894.

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Porcelain Products, Inc.

CAREY, OHIO

Electric Heating

(3) *The quality of the contractor's work affects customer acceptance. Discriminating users put the blame for defective installation where it belonged, but some took it out on the equipment.*

(4) *The contractor must learn to estimate capacity requirements and cost. The greatest proportion of customers expressing dissatisfaction had expected lower operating costs; some felt inadequate capacity had been installed.*

Customer comments bear out the fact that the majority of those who realize exactly what the cost of operation will be before installation are more than satisfied, even after years of use. Those who were given assurances of costs much lower than those actually experienced were justifiably indignant; many

TABLE 2: Suggested Uses for Supplementary Heat

Music Room	Camp Cabin
Den	Cellar Playroom
Photo Darkroom	Powder Room
Entrance Hall	Enclosed Breezeway
Recreation Room	Maid's Room
Attic Room	Workshop
Laundry	Enclosed Porch
Utility Room	Children's Playhouse
Room Built over	Room Built onto
Garage	Trailer

should not have been sold. Incorrect capacity estimates likewise caused discomfort and dissatisfaction.

The overall results of the survey were gratifying. Electric heat represents a rapidly growing market which is most appropriately sold by the electrical contractor. Its future is established; its potential is unlimited.

PORTION OF RESIDENCE HEATED

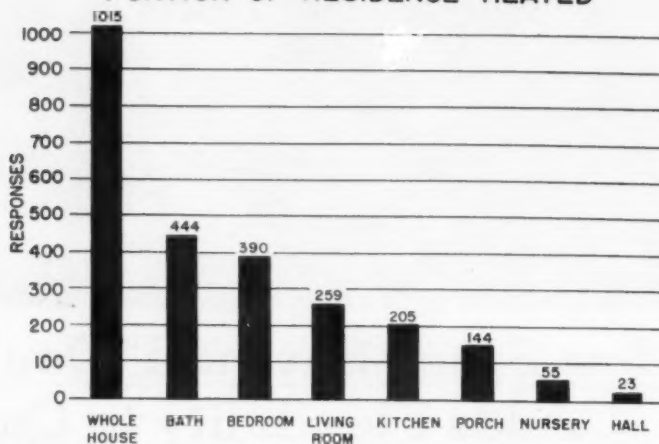


CHART 1: Analysis of the use to which the heaters were put by residential users of electric heat responding to questionnaire indicates the relative sales potential for auxiliary heat presented by the various rooms.

NUMBER OF HEATERS INSTALLED

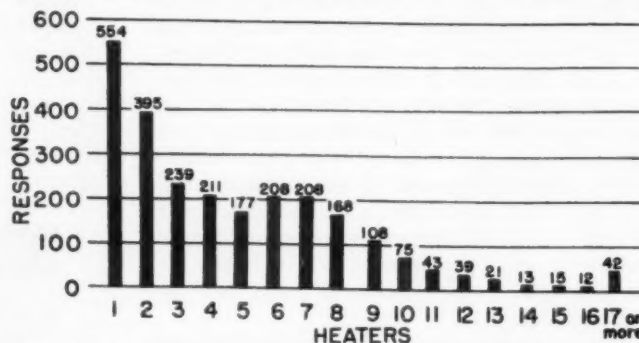


CHART 2: Number of heaters per customer varied from the single unit commonly used for supplementary heat to multiple installations involving 17 or more units.

up, **UP** again!

goes the value of the
RLM LABEL
on INDUSTRIAL LIGHTING units!



NOW you can specify RLM-Labeled
Lighting Units Specially Designed
for Moist or Dusty Locations!

NOW, also available
RLM units for the
high-output 800 ma. Lamps!

Now, extra value for all of the thousands of types, sizes and styles of fluorescent and incandescent lighting units which are available with the RLM Label!

Broadened RLM fluorescent specifications cover individual and continuous row tandem mountings for simplified installation, more rigid construction.

RLM's new Specs SS-1 and SS-2 for Special Service Fluorescent Units typify the RLM Label's even greater value to everyone who buys, specifies or installs industrial lighting equipment. These important new "SS" specs, from the one-piece, all-porcelain enameled steel reflector housing to corrosion-resistant lampholders, set up standards that insure lighting equipment that can withstand unusual amounts of non-hazardous dust and moisture.

New RLM Specs for units utilizing high-output 800 milliamper lamps, point up the thorough broadening of RLM Standards to keep pace with latest lighting developments. In fact, every specification in the new RLM Book has been strengthened, made more embracing, revised UP! Send for your **FREE COPY** of the 1958 RLM Specifications Book.

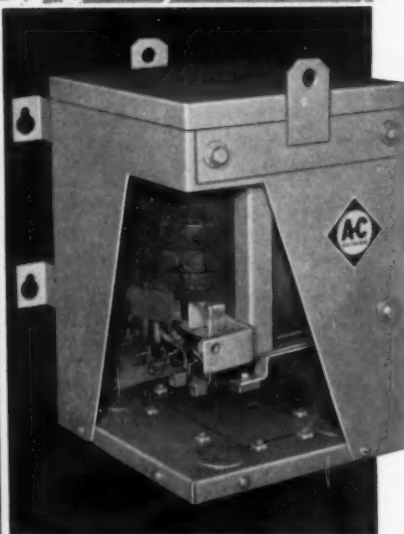
YOUR BASIC ASSURANCE OF HIGH QUALITY



This label identifies the RLM-certified lighting equipment of 27 leading manufacturers

For Free 1958 Specifications Book, Write, RLM Standards Institute, Suite 8197, 326 West Madison Street, Chicago, Illinois.

Are Your Transformer Requirements as Tough as the Navy's?



Cutaway model. Transformers are available in single-phase and three-phase designs, ranging from 3 to 75 kva, 600 volts or less.

IT isn't likely that utilities and industrial users subject dry-type transformers to the punishment the U. S. Navy expects its equipment to withstand. Yet, Allis-Chalmers gives you the same, extra-dependable dry-type transformers in "industrial-type" enclosures that the Navy installs in supercarriers, guided-missile destroyers and mine sweepers.

Allis-Chalmers totally enclosed dry-type transformers can save you as much as 20% on initial cost in place of an oil-filled unit. They are more economical to operate and can actually increase production. These units can be located outdoors, they're weatherproof—or indoors in dusty, lint-filled or moist atmospheres. They are quickly and easily mounted on walls, posts or machinery. Maintenance is virtually eliminated because there is no cooling liquid to change or filter — the coil is given maximum protection with high temperature insulating materials consisting of Fiberglas, asbestos based materials and silicone varnish.

For complete information, call your nearby A-C representative or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-5637



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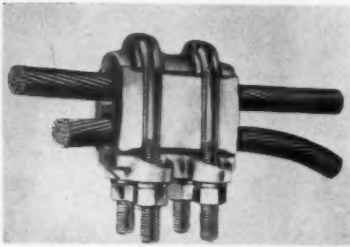
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Product News



Connector (1)

Heavy duty all aluminum parallel groove clamp connects copper, aluminum, ACSR in feeders, transmission, primary distribution. Three connector sizes cover the range from 3/0 through 954 MCM. Special aluminum U bolts and tapered bell mouths minimize cold flow and eliminate cable chafing. A modified V groove produces wiping action on the cable and assures electrical performance over the full range of the connector. Overlapping spacer tabs keep cable strands from splaying.

Burdny Corporation, Norwalk, Conn.

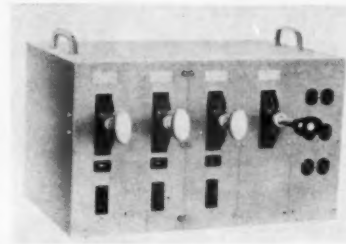


AC Speed Control (2)

VarEPack is the name of a new, all ac, adjustable speed drive. The control cabinet for the system operates directly from an ac supply line and directly feeds an ac motor. The system consists of an induction motor, an operator's control station and a control cabinet. Speeds can be selected or changed manually or automatically by remote control while the equipment is either idle or in motion. Required speed is maintained constant through load fluctuations. Control features include: smooth starting and stopping, acceleration and deceleration, positive reversing, infinite range of stepless speeds and jogging, inching and creeping. Torque is adjusted accurately to meet the de-

mands of the operator and the driven load. Drive is available in ratings from 1 to 50 hp, and higher for certain applications, for operation from 208, 220, 440 or 550 volts, 3-phase, 60 cps.

The Electric Products Company, 1725 Clarkstone Road, Cleveland 12, Ohio.



Lighting Control (3)

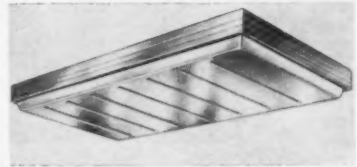
A "packaged" lighting control, called Controlette, is designed for application in schools, small stages, restaurants and churches where simplified manual, interlocking control is most practical. It features standardized 3-, 4-, 5- or 6-unit assemblies equipped with Varistat controllers, palm fitting handles and vertical straight line arrangement of handles, indicating lamps and switches. Each controller has a maximum output capacity of 2500 watts. A 4-unit lighting controller with total output rating of 10,000 watts measures 25½ in. by 14⅞ in. by 16⅞ in. Bulletin 76P is available.

Ward Leonard Electric Co., Mount Vernon, N. Y.

Chime (4)

A new chord chime line, known as Chordette, is available in two versions. Model C-37 combines in a single unit, an eight-note melody, front door signal, and a dual-chord two-note chime, back door. Each note in the dual-chord sound consists of two notes struck simultaneously. A standard two-note third signal is also provided, for optional use as a sick call, privacy protector or telephone code call. Model C-35 has a dual-chord two-note front door signal, each note a chord being made up of two simultaneous tones. The back door signal is two-note melody.

Edwards Company, 90 Connecticut Ave., Norwalk, Conn.



Fluorescent Fixture (5)

The SSDVO series of open-top design fluorescent fixtures features a shallow modular fixture with 24-in. by 48-in. vinyl plastic bowl diffuser. The chassis is stamped with thin continuous horizontal bands on side and ends, giving the effect of a recessed type fixture. Unit may be either surface mounted or suspended as a direct-indirect unit. Available with two or four lamps and a choice of four vinyl diffuser patterns.

Leadlight Fixture Co., 800-100th Ave., Oakland, Calif.



Limit Switch (6)

New proximity limit switches are designed for operating life to be independent of switch operations performed. Electrical output of the devices—24 volts dc at 0.335 amps—is adequate to drive both Cypak and other static control elements and 24-volt dc relays and solenoids. The switch consists of two parts. An encapsulated sensing element measuring 2 by 2 by 1½ ins. contains an open "C" core and two windings as elements of a variable reluctance bridge circuit. A steel-encased sealed control element contains a balance circuit, amplifier, phase detector, precision flip-flop circuit, transistor output amplifier, and power supply. Dimensions are 6 by 3 by 7½ ins. Power supply required is standard 117 volt ac.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 22, Pa.



"A drop in the bucket!" The constructions shown here by Tom Weichel, Okonite's portable cable engineer, are just a random sampling of the flexible cords and cables that Okonite has developed for industrial operations. More than likely, Okonite has available right now the exact cable you need—in terms of toughness, flexibility, capacity, resistance to oils, acids, alkalies, water, heat and abrasion. If not... we know how to build it!

Here's how we add value to your portable cable dollar

Behind these cable constructions are service records that prove the extra long life of Okocord flexible cords and portable cables under the most severe industrial conditions of mechanical abuse, run-overs, heat, oil, moisture, and constant dragging over cement floors.

Longer cable life means lower operating costs... reduction of costly work stoppages... greater utilization of expensive equipment. Truly, Okocord's longer life represents money in the pocket for any plant operator.

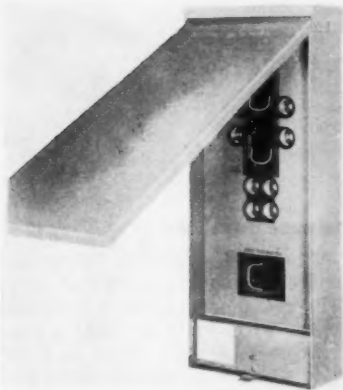
Here's how Okonite assures maximum value for your cable dollar.

1. By the use of materials developed in 80 years of making the finest cables.
2. By constant research to find even better materials and constructions.
3. By intimate, first-hand knowledge of industrial problems and conditions.
4. By self-imposed standards for manufacturing and testing that are more exacting than the industry requires.

There are Okocord quality cables for your machinery and portable equipment. There are Okonite specialists ready and willing to help you in the planning or installation stages. And there is a brand new booklet full of valuable hints on picking the right cable constructions for your all-important power or control circuits. Write for free Bulletin EC-1117—"How to choose insulated cable"—to The Okonite Company, Passaic, New Jersey.



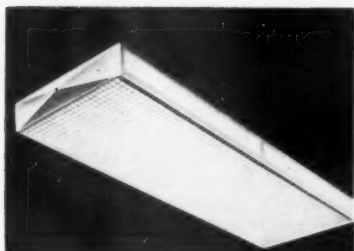
where there's electrical power... there's **OKONITE CABLE**



Enclosures (7)

New raintight, NEMA Type 3R enclosures with interchangeable conduit hubs are now available for all 60-amp series connected and 100-amp parallel connected fuse puller panels. The new series-connected panels are rated 60 amps, 120-240 volts ac, single-phase, 3-wire. They are available with an extra puller and up to 12 plug fuse branch circuits. Neutral provisions include both insulated groundable and grounded. All parallel-connected panels are rated 100 amps, 120/240 volts ac, single-phase, 3-wire, and are available with up to four pullers and provision for 4 to 12 plug fuse branch circuits. All parallel panels have grounded neutrals. Listed by UL.

General Electric Co., Circuit Protective Devices Dept., Plainville, Conn.



Fluorescent Fixture (8)

A new commercial fluorescent lighting fixture, the Ortho 66, is a straight-line design with plastic egg-crate louver. It connects to the power source through a built-in plug which engages a receptacle in the "Uni-Race", the patented Gibson wire channel housing the branch circuit wires. Uni-Race, approved by UL as a raceway, can carry circuitry for 225 amps or five No. 8 AWG wires. Fixtures can be mounted in continuous rows; or they may be mounted at intervals of 4, 8, 12, or more feet.

Additional fixtures can be plugged into the intervening space at any time. Two-light fixtures can be replaced with 4-light.

Gibson Manufacturing Co., Atlanta, Ga.

Ceiling (9)

Luminated ceiling diffuses light uniformly from wall to wall without glare, shadows or high spots. It streamlines the ceiling by concealing pipes, air conditioning ducts, conduits, sprinkler heads, etc. Ceiling consists of continuous rows of corrugated vinyl plastic sheets supported by an aluminum framework beneath a structural ceiling. It is for installation in either new or remodeled interiors. Framework which supports ceiling material is of all-metal construction.

Thermotank Corp., John J. Fannon & Co., 3000 E. Woodbridge St., Detroit 7, Mich.



Transformers (10)

Two new constant voltage transformers in 2 kva and 3 kva capacities feature a new output arrangement permitting 3-wire 118/236-volt loading. Load may be distributed among any or all three outputs, provided total rating of transformer is not exceeded. Regulation is plus 1% on either 236-volt or 118-volt loads alone. The new multiple primary has provision for 115-, 208-, and 230-volt inputs. Any three stock units of the same rating may be connected in delta to 3-phase power sources, providing distribution of the total load among the phases. Single-phase outputs may be connected either grounded-neutral wye; or to isolated single phase loads. Response time for correcting line voltage variations is within 1.5 cycles. Regulating action is automatic and continuous.

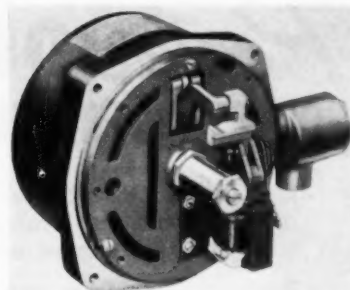
Sola Electric Co., 4633 West 16th St., Chicago 50, Ill.



Timer (11)

A new synchronous motor-driven timer available with 1-, 3- and 5-minute timing units, includes many new design features. The 1-minute unit is adjustable in one second increments, 0 to 60 seconds; the 3-minute unit is adjustable in 3-second increments, 0 to 180 seconds; and the 5-minute unit in 5-second increments, 0 to 300 seconds. A terminal board and mounting base combination provides an easy interchange of the dimensionally identical timing units. Quick-make and quick-break contacts in the timer's housing, mate with terminal strips on the mounting base to eliminate all interwiring. Motor operates on 110 volts, 60 cycles. For 220-, 440- or 550-volt, 60 cycle service, a control transformer and terminal block is added.

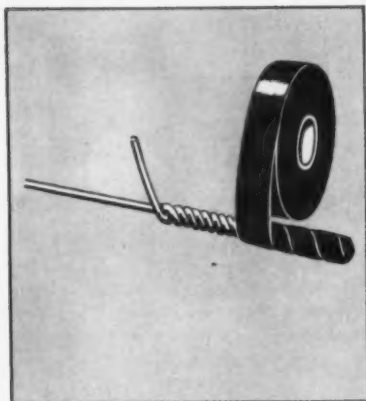
Cutler-Hammer Inc., 228 N. 12th St., Milwaukee 1, Wis.



Brake (12)

A UL approved style UH76A-9 brake with a maximum torque rating of 105 lbs ft, is suitable for mounting on the NEMA "C" flange of motor frames 213 through 256U. By use of an adapter, mounting on 284U and 286U motor frames is possible. This addition to the Class I Group D line can be offered for floor or motor mounting, horizontal or vertical mounting, ac only. "Unitizing" construction is used.

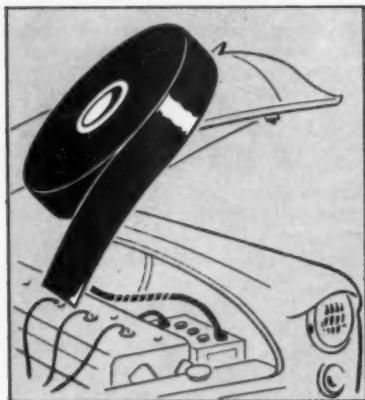
Stearns Electric Corp., 120 N. Broadway, Milwaukee 2, Wis.



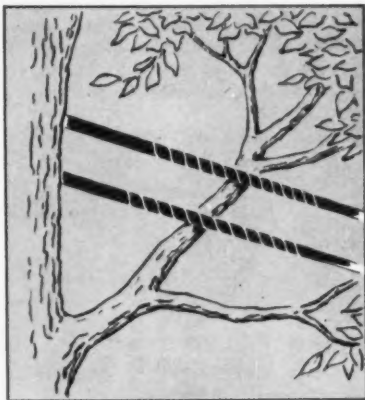
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FLEXIBLE AT LOW TEMPERATURES



PERMANENT FAST STICKING



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OUTSTANDING ONE-WRAP PRIMARY INSULATION

Porter[®] QUIK-STIK POLYETHYLENE ELECTRICAL TAPE

• IDEAL FOR ALL OUTDOOR AND INDOOR, UNDERGROUND OR OVERHEAD WIRING, IN UTILITIES, ELECTRONICS, AIRCRAFT, AUTOMOTIVE, AND GENERAL USE.

- Permanent strong tack—sticks anywhere!
- Stays flexible from minus 70° F to plus 200° F.
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- Resists acids, alkalies, oils, solvents, fungus, bacteria, gases.

GET FULL INFORMATION on new Porter QUIK-STIK polyethylene tape by writing the Quaker Rubber Division, H. K. Porter Co., Inc.; Philadelphia 24, Pa., or Pittsburg, Calif.

H. K. PORTER COMPANY, INC.
QUAKER RUBBER DIVISION



Fluorescent Light (13)

A new, all-aluminum fluorescent service station island lighter especially designed to operate most efficiently with VHO or SHO lamps. Light chambers are tilted at a 20° angle to provide greater light distribution and are separate from the center channel in which the transformers are housed. Air circulates between the light chambers and the center channel, dissipating the heat generated by the transformers. Unit is produced in 4-, 6- and 8-ft lengths, wired, ready to mount on pole. Luminaires can be combined by removing end plates and bolting units together.

Revere Electric Mfg. Co., 7420 Lehigh Ave., Chicago 31, Ill.

Junction Box (14)

A new flush type junction box, Type EGJ, to simplify electrical installations in gasoline service station pump islands. Cover of explosion-proof and dust-ignition-proof Condulet is supplied with an "O"-ring gasket, making assembly rain-tight. Sealing hub Condulets are available for threading into the bottom of EGJ for sealing the main feeder conduit. There are two additional drilled and tapped conduit entrances in the bottom, and six in the sides. Plugs are provided for two bottom entrances and four of the side entrances, to provide choice of conduit arrangement. Type EGJ is available in two sizes. Literature is available.

Crouse-Hinds Company, Syracuse 1, N. Y.

Foot Switch (15)

The new Pedaline foot switch can be applied wherever switching of electrically operated equipment is required. Contact rating is 5 amps at 115 and 230 volts, 60 cycles. Dimensions are 3½ ins. long, 2½ ins. wide, 1 in. high. Weight is 7-oz single switch; 7½-oz double switch. Finish is baked-on light gray Hammer-tone enamel with black rubber foot pad.

Line Electric Co., 271 South 6th St., Newark 3, N. J.

Troffer Fixture (16)

A new series of shallow recessed troffer fluorescent lighting fixtures. They are 5½ ins. deep, available in a variety of 1-ft and 2-ft wide models and offer a wide choice of shielding media. The new troffer line provides three different chassis types to meet the requirements of the various ceiling systems. Fixture is built with "Snap-Up Hangers" already in place so that when troffer is pushed through the ceiling opening, the toggle arms on the hanger spring out to rest on ceiling-supporting elements parallel to troffer. "Lay-in" troffers and "end-support" units which do not require the snap-up hanger are also available. Entire line has been designed to fit in shallow plenums.

*Sylvania Electric Products Inc.,
1740 Broadway, New York 19, N. Y.*



Enclosure (17)

An enclosure for burying distribution transformers in residential neighborhoods. Designed for use in new housing developments where electric power lines go underground, it provides a safe place to put a standard pole-type transformer. Ratings up to and including 167 kva in the 15,000-volt class can be accommodated. Enclosure consists of a low, dome-shaped steel cover hinged to a section of standard 48-in. corrugated culvert pipe. Baffled vents allow cooling air to enter and leave unit. Both primary and secondary leads are brought up to the transformer from underneath, through the gravel bed on which the corrugated casing rests. The domed cap projects 33 ins. above grade. Enclosure is painted the same blue-gray used for pole-type transformers. Cover can be padlocked.

General Electric Co., Schenectady 5, N. Y.

the BIG LINE of HEAVY-DUTY EXTENSIONS...



ROYAL ELECTRIC

"POWR-KORD"

Safe, dependable Royal "Powr-Kords" stand up even under roughest usage because they're built strong to last long. MOLDED-ON caps and connectors with built-in strain reliefs are firmly vulcanized to top quality Royal Types S, SJ, or SJT cord. Heavy brass blades and double-wipe contacts . . . locked in solid rubber or vinyl . . . cannot wobble, work loose, or pull out.

FULLY UL LISTED

Colors . . . black and red rubber, red and yellow vinyl. (Safety engineers recommend yellow — the high-visibility safety color.)

Cord lengths . . . 10' to 100' rubber, 25' to 100' vinyl

Sizes and types

Type SJ	Rubber jacket, sizes 18 and 16 — 2- and 3-Conductor
Type S	Rubber jacket, sizes 18 through 12 — 2-Conductor
Type S	Rubber jacket, sizes 14 and 12 — 3-Conductor
Type SJT	Vinyl jacket, sizes 18 and 16 — 2-Conductor

Order rubber or vinyl "Powr-Kords" from your wholesaler, or write for Catalog No. 3-57, giving wholesaler's name.

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**Save 40% in time,
labor, materials with
Ramset and Shure-Set!**

That's what a Baltimore contractor saved . . . 40%. That's the kind of saving you can expect when you use—

***RAMSET** for heavy-duty fastening to steel and solid concrete . . . **SHURE-SET** for light fastening to masonry and concrete block!*

You get the lowest in-place cost without drilling, bolting or plugging. No power lines, no bulky equipment. You increase your profit two ways on every job!

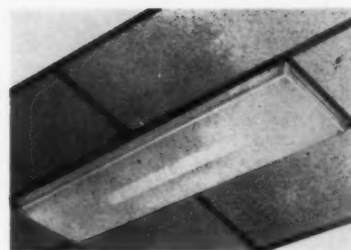
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Powder-actuated RAMSET is up to 15 times faster than old-style fastening methods. Completely portable. Every RAMSET fastener is 100% guaranteed, and it's Austempered for high hardness combined with maximum toughness.

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Ask your RAMSET dealer to supply both tools. Look under "Tools" in the yellow pages, or write for free booklet today!



Troffer (18)

A new troffer, known as Slendex, recesses 1½ ins. Unit is shielded by an extruded and formed polystyrene diffusing panel, which has a glare-free surface finish. The panel's triangular inverted center section eliminates dark streaks. For relamping or servicing, the diffusing panels swing open and can be removed. Slendex is also available as surface units. All units, both recessed and surface, are available in 1- and 4-ft units for two rapid-start lamps, and 2- by 4-ft units for four rapid-start lamps. Literature is available.

Smithcraft Lighting, Chelsea, Mass.

Conduit Straps (19)

A new line of heavy duty one-hole snap-on conduit pipe straps with two-rib reinforcement. Straps, made of hot-dipped galvanized steel, are available in types for EMT and rigid conduit. Every strap is stamped with size and type. Rigid-type straps are made in sizes from ½-in. to 4-in. EMT straps are made in sizes from ½-in. to 2-in.

Gedney Electric Co., 1270 Sixth Ave., New York 20, N. Y.

Cable (20)

Now available are rubber (GR-S, oil-base, butyl and silicone) insulated power and control cables sheathed with aluminum. The sheath is applied by the continuous extrusion process. Advantages are—lightweight protection, easily worked, can be trained to fit the contour of any installation, moisture-proof, and has many protection advantages in the petro chemical and atomic industries.

General Cable Corp., 420 Lexington Ave., New York 17, N. Y.

Connector (21)

Model HNS-23 introduces a new type of service entrance connector. It features a hex-nut threaded casting to compress the neoprene gland directly to the hub of the meter socket. The hub, with conduit stop,



Ramset Fastening System

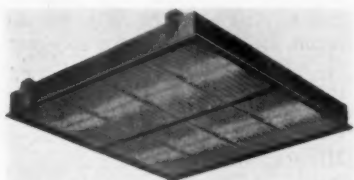
WINCHESTER-WESTERN DIVISION
OLIN MATHIESON CHEMICAL CORPORATION

12105-G Berea Road

Cleveland 11, Ohio

becomes the cavity for the neoprene gland and, as the compression nut is threaded into the hub, the conical sleeve compresses the neoprene equally around the cable. Other features include a conical metal sleeve to provide ample take-up around the cable; less stock required with a single wide-range 1½-in. connector to handle all sizes of 100-amp rated cable.

M. & W. Electric Mfg. Co., Inc., East Palestine, Ohio



Fluorescent Fixture (22)

A new line of fluorescent Visionaire fixtures, featuring the Holo-phane Primalume Controlens. A variety of standard, modular sizes and design configurations permit a wide latitude of application, both for surface and recessed mounting. The surface-mounted fixtures are slim, shallow and light-tightness of inside-lapped corners. The single-element lens panel and its frame is released at the touch of a fingertip to the touch-type latch, and it swings open for relamping. The entire panel may be removed, even from the 4-ft sq fixture, without the use of tools. The recessed units fit flush with the ceiling. Modular fixtures come in sizes 2 ft by 2 ft, 2 ft by 4 ft and 2 ft by 8 ft.

Sunbeam Lighting Company, 777 E. 14th Place, Los Angeles, Calif.

Switchgear (23)

A new line of indoor and outdoor 4.16-kv horizontal drawout metal clad switchgear, Type D, was designed for greater ease in installation, maintenance and operation. A feature of the line is a new "Ruptair" power circuit breaker, Type MA, with improved interrupting characteristics to meet such needs as a 2-cycle operation. Current transformers are mounted in the unit in a separately grounded metal barrier accessible from the breaker compartment. The "tilt-out" potential transformer or control power transformer can be mounted in the top rear of the standard 72-in. high breaker unit or auxiliary compartment.

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

ELECTRICAL CONTRACTORS!

Use this fast portable trencher for cable, pipe, tubing, conduit

POW-R-SPADE narrow trenches cost 1c to 5c per foot including labor.

Saves 80% - 90% cost and time compared to sub-contract or hand digging.

Ready to go on the job, at once — no costly waiting around.

Can pay for itself in one day's operation.

POW-R-SPADE digs a neat 3" wide trench. Dirt is delivered well pulverized on each side of trench — no lumps or clods. Easy to back fill.

STAMPINGS

POW-R-SPADE

MADE BY STAMPINGS, INC.
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WE ADMIT that these are strong statements. And yet, POW-R-SPADE users confirm them again and again. For here is a machine that is ideal for trenching 3" wide to 24" deep, where larger machines are costly and impractical; where hand labor is slow and expensive. No heavy wheel marks or unnecessarily wide trench to scar lawns. Digs right up to foundation of building. Goes 1½ to 17 feet per minute, depending upon soil conditions.

A rugged machine. Easy to set and to operate. Oil-sealed bearings. Powered by a well-known engine. Minimum maintenance. Shipped completely assembled, ready to go to work for you. Additional interesting details and information immediately yours upon return of the coupon.

Portable from job to job.
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APPROVED and recommended by hundreds of users in every area of the United States.

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Stampings, Inc., 1017½ Mound St., Davenport, Iowa
Please send material on POW-R-SPADE to:

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Company

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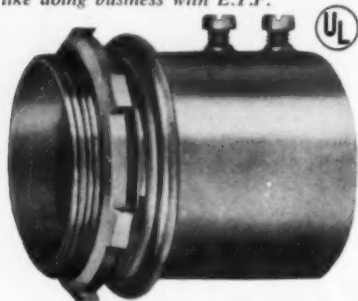
City State

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"NO PRICE
WORRY..."**

**WHEN I BUY
ETP
QUALITY
FITTINGS"**



E.T.P. always takes care of me on price and quality! As a supplier, they've certainly earned my confidence—and the confidence of my customers. I know their price is consistently competitive—their connectors and couplings consistently superior. I like doing business with E.T.P.



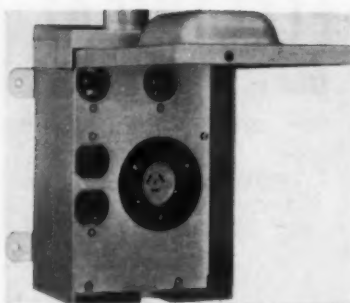
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EXCLUSIVE ADVANTAGES:**

- Exclusive Pre-Set, Deep-Slotted Staked Screws. No backing out for conduit.
- Concrete tight! Far surpasses U.L. requirements. U.L. File Card E24788.
- Precision beveled edges with new, extra heavy duty precision locknut.
- One piece solid tubular steel—cannot open or spread. Sized for uniformity.
- Lustrous zinc, heavy plated finish with heaviest gauge wall thickness.
- Available in ½", ¾", 1", 1½" (one screw type) and new 1½" and 2" sizes (two screw type).

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Write for free samples and brochure

ETP
ELECTRIC TUBE PRODUCTS
74-18 Grand Avenue, Maspeth, (N.Y.C.) N.Y.



Power Outlets (24)

Two new power outlets designed for use in mobile home parks have been added to this line. Models 3515 and 3500 provide electric outlets for mobile home coaches equipped with Theodore Bargman 35-amp, 120-volt plugs. Model 3515 features a Bargman 35-amp, 120-volt receptacle protected by a 30-amp fuse holder. It also has a 15-amp grounded duplex receptacle with fuse holder to service smaller mobile home coaches and accessories such as automobile head bolt heaters. Enclosure cover can be closed and padlocked while receptacles are in use. A 1-in. top hub and three bottom knockouts in the enclosure facilitate either overhead or underground connections. Mounting the enclosure is simplified by steel straps which may be wrapped to fit a pole.

Hoffman Engineering Corp.,
1503 Tyler St., Anoka, Minn.

Instrument (25)

A new explosion-proof hour meter, specifically designed for use on fork lift trucks, gasoline or diesel engines, generators or air compressors which might be located in hazardous locations. Available for 12- and 32-volt dc applications, instrument is housed in a specially designed, explosion-proof case which is approved by UL under Class 1, Group D specifications.

John W. Hobbs Corp., Yale Blvd.
and Ash St., Springfield, Ill.

Clock and Program System (26)

A master clock and program system for use in commercial, industrial and public buildings. System includes a master clock, which usually is mounted in the office of a school principal or building engineer, and any number of secondary clocks located throughout the building. Also included is a programmer that breaks an electrical circuit at specified intervals to sound

a bell, stop or start heating and air conditioning equipment or turn lights on and off at certain times. A feature of the programmer is that its sequence can be changed by hand. By incorporating the clock and program system into Honeywell's Supervisory DataCenter, the building engineer, without leaving his desk, could: Monitor and adjust temperatures in any area of the building; synchronize operation of any number of secondary clocks; adjust the programmer to ring bells for relief periods, lunch, etc., or provide for automatic setback of temperature levels during nonworking hours.

Minneapolis-Honeywell Regulator Co., 2747 Fourth Ave., South, Minneapolis, Minn.

High Voltage Capacitor (27)

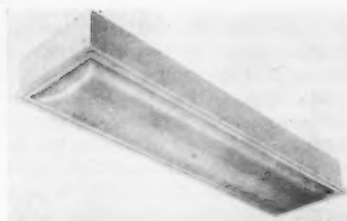
A newly designed underground high voltage capacity equipment specifically designed for underground vaults and manhole installations subject to submersion, features corrosion-resistant 50 kvar capacitors with precision-welded, corrosion-resistant terminal boxes for cable connections. The apparatus finds application where there is an overhead system without pole space for capacitors or where an entire system is underground. It is also suited for application in severely contaminated atmospheres where capacitor bushings become coated with conducting material, or where clearances from live parts to buildings or personnel would not be adequate with other types of capacitor equipment. Capacitor units, single-phase, 2400 volts, are connected for grounded-ye operation and mounted in a steel rack. Available in either 150 or 300 kvar ratings, 4.16 kv.

General Electric Co., Schenectady 5, N. Y.

Generators (28)

A complete line of 50, 60 and 400 cycle brushless ac generators are available in both single and 3-phase output with all standard commercial voltages available throughout the range of sizes offered in brush type alternators. The 60-cycle, 3-phase sizes extend from 5 to 400 kw and 400-cycle from 1 to 250 kw, revolving field types in all standard commercial voltages through 600 volts. Some sizes are available in the higher voltages of 2300 or 4160 volts.

Kato Engineering Co., Mankato, Minn.



Lighting System (29)

A new fluorescent lighting system designed for operating rooms which provides high light levels without discomfort by utilizing an asymmetric beam. The new Alkco No. 223-1 utilizes a prismatic controlled, asymmetric beam which concentrates the light on and around the operating table, while providing uniform, comfortable, shadowless general lighting throughout the entire room. Unit may be recessed or surface mounted. By utilizing a prismatic controlled diffuser in combination with certain internal fixture design advancements, and installing the units in a continuous rectangle around the operating light center, a carefully calculated asymmetric beam is achieved. Data Sheet DS-566 is available.

Alkco Mfg. Co., 4242 Lincoln Ave., Chicago 18, Ill.

Switches (30)

A new line of low-voltage switches, Series 50, is now available to the building industry. They can control from one to six electrical currents and are all designed to mount to a single gang box or switch plaster ring. A feature is its half-inch depth. It can be installed in a sliding door pocket and in other limited locations. Other features include modern design, snap-on cover plates.

Touch-Plate Mfg. Corp., Long Beach, Calif.

Cord Connector (31)

Type CGBS explosion-proof sealing cord connector. Sealing compound is poured when the connector is installed. A wire ring holds the cord in the compound, which hardens to form an effective seal. Clamping nut has an integral cord clamp which insures positive locking action on the portable cord, preventing accidental withdrawal from the connector. Connector is available in sizes to fit cord from 1/4-in. to 1 1/2-in. in diameter.

Crouse-Hinds Company, Syracuse 1, N. Y.



Each of the two illustrated troughs can carry as much cable as all of the paralleling conduit.

Cope cable trough saves steel by the ton!

Problem. 100 miles of cable to be supported in a New Jersey power generating station.

Solution. A careful cost analysis of available methods and materials convinced plant engineers that Cope's expanded-metal cable trough was the best choice. Why? Among other reasons, it meant a saving of more than a ton of steel for every 60 feet of trough installed, as compared to conduit . . . a total saving in excess of 250 tons of steel for the 15,000 ft. of trough required for the completed job!

Here's How You Save. One 10 foot section of 24" width Cope trough supports as many cables as 16 lengths of 4" conduit and it only weighs 54 lbs., compared to 575 lbs. for this same amount of conduit. This adds up to real economy regardless of the size of your installation. Cope's expanded-metal cable trough simply uses less

steel to do the job and obviously this can mean substantial savings for you!

Cuts Labor and Maintenance Costs, Too. Design and construction features of lightweight Cope trough speed installation of space saving systems—even in the most cramped quarters. Easy-to-get-at trough simplifies cable inspection and repair . . . provides ready re-routing and facilitates system additions.

You save *three* ways when you specify Cope cable supporting equipment . . . trough, ladder or channel.

- LOWER FIRST COST
- LOWER INSTALLATION COSTS
- LOWER SYSTEM MAINTENANCE COSTS

Discuss these advantages for your installation with a qualified Cope representative—or write to T. J. Cope Division, Rome Cable Corporation, Collegeville, Pa.

T. J. COPE *Division*

ROME CABLE CORPORATION



CORD STRETCHING



SOCKET SNEAKING



are "evils" millions of people will read* about in Plugmold advertising. Naturally we're telling them how you can eliminate such irksome problems forever with Plugmold. Yes, the crusade is on and it will grow—the chance to lead is yours.

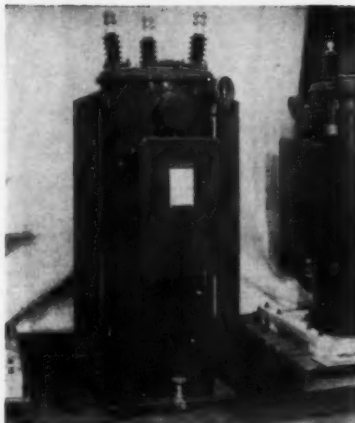
*Saturday Evening Post Time

House Beautiful's Building Manual
House & Garden's Book of Building
Home Modernizing
New Homes Guide



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by **WIREMOLD®**

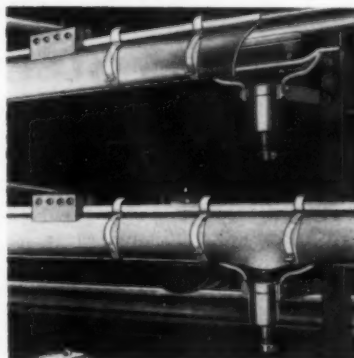
THE WIREMOLD COMPANY
Hartford 10, Connecticut



Regulators (32)

Six new higher-capacity ratings have been added to the ML-32 line of step-type feeder voltage regulators. The new substation ratings are 125 and 167 kva in the 2,500- and 5,000-volt classes, 250 kva in the 7,260-volt class and 138 kva in the 13,800-volt class. At reduced regulation range, 2,500-volt units, 75 and 100 kva, can now carry 480 amps or 160% of rated current, whichever is less.

General Electric Co., Schenectady 5, N. Y.



Trolley System (33)

A new electrical trolley system will carry high amperages required by heavy-duty cranes and similar equipment. Components include an extruded, copper conductor bus; a sliding collector shoe of self-lubricating alloy copper; and a flexible protective sheath covering both bus and shoe. A Koroseal sheath is used for inside applications, Neoprene and nylon for exterior. In crane bridge electrifications the collector shoes can be mounted on a horizontal plane on minimum spacing of 3 ins. This is a copper-to-copper system which maintains total area of contact between conductor and collector. System is

self-de-icing on exterior installations subject to freezing rain or snow. Safety trolley system is for installations from 110 to 600 volts. Collectors are for from 70 to 1125 amps. Five sizes of conductor bus are available, with electrical carrying capacities from 325 to 4500 amps. Bulletin is available.

U-S Electric Mfg. Co., 1042 Banksville Road, Pittsburgh 16, Pa.

Transformers (34)

A new line of dry-type transformers for the I-T-E line of unit substations. The transformers feature solid copper secondaries and a unique system for clamping coils to core assemblies. Class H insulation is used. The ventilated unit can operate unattended except for the need for periodically blowing out dust that collects on the core and coil assembly. Substations are available for distribution applications in a range of 300 kva through 2000 kva. Primary voltages available range from 2400 volts through 15 kv; standard secondary voltages from 120 through 600 volts are available.

I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.

Work Tower (35)

An improved motor-lift one-man work tower telescopes through standard door frames and has direct acting hydraulic lift. Available in 110-volt ac plug-in and 12-volt dc storage battery powered models; elevation and descent controlled by foot buttons on work platform; telescopes two ways to pass through small openings; explosion-proof motors available. The four-legged base—61 in. by 61 in. when locked in working position—can be folded to 30 by 80 in.

Safway Steel Products, Inc., 6234 W. State St., Milwaukee 13, Wis.

Motors (36)

A new line of heavy-duty capacitor-start induction-run single phase integral hp motors designed to provide high starting torque and operating efficiency. For starting, the new motors use capacitors of the dry electrolytic type designed for maximum starting torque with minimum current usage. When motor gains speed, a centrifugal switch cuts out the capacitors for straight induction run. These single-phase induction motors are

especialy suited to the severe conditions and high starting torque required for service with pumps, fans, drill presses, lathes, sanders, circular saws and similar equipment. Type WCZK single-phase 60-cycle, 115/230-volt motors are available from $\frac{3}{4}$ hp to 1 $\frac{1}{2}$ hp at 1200 rpm, 1 hp to 3 hp at 1800 rpm, and 1 $\frac{1}{2}$ hp to 5 hp at 3600 rpm.

Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 6, Ill.

Terminal Block (37)

A single pole, unit design, terminal block, identified No. 13000, is available in factory assembled strips or for custom assembly. Units are insulated by individual barriers. Connections are made without disturbing the switch assembly. Each unit is provided with a marking strip for identification of the circuit. Custom-assembled units are snapped onto the spring channel, and may be combined with screw, and pressure connector units. Bulletin No. 13 is available.

Marathon Electric Mfg. Corp., 12th & Cranberry Sts., Erie, Pa.

Clamp (38)

A new bronze dead end strain clamp, Type BDE is a cast, high tensile, bronze alloy, straight line clamp, available in a wide range of sizes. It uses "Snub-Seat" and is equipped with a "come along" eye for ease in sagging cable with stringing tackle. The BDE clamp also includes a one-piece keeper with U-bolts for inserting cable, as the U-bolts are long enough to insert the cable without removing nuts. These features are available in all sizes of BDE clamps.

Anderson Electric Corp., Birmingham, Ala.

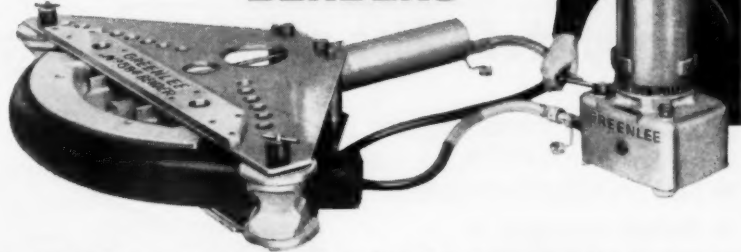
Control (39)

A master heater control, called Weather Control, combines an inside program time switch and outdoor weather head providing "balanced" heating. An automatic cut-off is a feature of the unit. It also makes provision for an auxiliary switch for hold-fire and stoker operation. Heat is cycled on the inside control panel according to outdoor temperature and indoor building satisfaction: the Weather Control starts and stops the heating plant at pre-selected intervals as programmed on the 24-hour dial.

Heating Controls Div., Tork Time Controls, Inc., Mount Vernon, N. Y.



LIGHTWEIGHT HYDRAULIC CONDUIT BENDERS



No. 884 Hydraulic Power Bender for conduit sizes $\frac{1}{2}$ " - 4". For faster, easier 90° bending of conduit in ten sizes up to 4" . . . makes full 90° bend with one ram stroke. Operated with the GREENLEE No. 798 Power Pump as shown here, the GREENLEE No. 884 Power Bender bends 4" conduit or pipe 90° in just four minutes . . . makes same bend in only thirty seconds with No. 797 Power Pump. Develops 40 tons ram pressure — yet high-strength aluminum and steel construction reduces weight to minimum. Easily wheeled from job to job on pipe supports specially designed to serve as rollers. Operates in any position. Conduit is inserted and removed from front . . . one pair of universal pipe supports rotates to handle all pipe sizes . . . a dozen special features place this new bender in a class by itself for versatility, speed, and ease of setup and operation by one man.

No. 880 Lightweight Hydraulic Bender for conduit sizes $\frac{1}{2}$ " - 2". Makes full 90° bend with one ram stroke . . . assures uniformity of bends in pipe and conduit of $\frac{1}{8}$ " through 2" sizes. One man easily carries and operates the GREENLEE No. 880 Hydraulic Bender . . . simplified quick setup. Ram fits GREENLEE thin-wall conduit, tubing, and bus-bar bending attachments. Designed for easy hand-pump operation, the No. 880 also teams with a GREENLEE power pump for production jobs.



No. 770 Hydraulic Bender for conduit sizes $\frac{1}{4}$ " - 3"

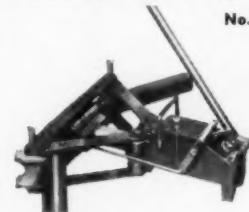
Maximum piston pressure of 25 tons for fast, easy bending. One-man operation. Easily operated by hand or a power pump, the No. 770 Bender makes fast, smooth bends without the use of heat or filler. Extra attachments available for bending $\frac{1}{2}$ ", $\frac{3}{4}$ ", and 1" sizes.

No. 775 Hydraulic Bender for conduit sizes up to 5"

Similar to the No. 770 Bender, but is designed to bend larger size conduit and has a maximum pressure of 40 tons. Will easily make smooth, precise bends in cold conduit and pipe. Either hand- or power-pump-operated. Shoes and supports available for this machine make it possible to bend eight sizes of pipe from $\frac{1}{4}$ " to 5".

Nos. 770-T and 775-T Thin-Wall Hydraulic Conduit Benders.

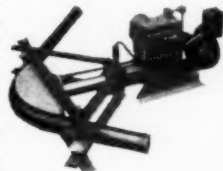
GREENLEE No. 770 or 775 Power Unit with attachments to make a full 90° bend with one ram stroke and prevent crushing and kinking of thin-wall material. The attachments bend $\frac{3}{4}$ " - 2" thin-wall conduit . . . easily and quickly applied to the No. 770 or 775 Power Unit.



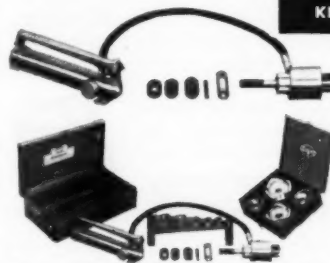
Nos. 770-BB and 775-BB Hydraulic Bus-Bar Benders.

For making accurate bus-bar bends in a wide range of sizes. Consists of the No. 770 or 775 Power Unit fitted with a GREENLEE bus-bar bending attachment. Regular "U" bends, 90° bends, or offsets are easily made in any size bar up to 6" wide and 1" thick.

No. 785-BE Power Bender. A powerful portable bender for heavier bending. Develops 100 tons of ram pressure to bend rigid conduit or standard pipe in $\frac{1}{4}$ " to 6" diameters, and is rugged enough to bend 5" extra-heavy or double-extra-heavy material with ease. 20" stroke permits 90° bends in one setting. Can be driven by either an electric or gasoline motor.



KNOCKOUT PUNCH DRIVERS AND PUNCHES



Make smooth holes for conduit in seconds with a GREENLEE Hydraulic Knockout Punch Driver and GREENLEE Knockout Punches. Use driver with all size punches for conduit $\frac{1}{2}$ " through 5". Driver available separately (No. 7646A), or in handy sets with ten punches for $\frac{1}{2}$ " to 4" conduit (No. 7310), or with six punches for $\frac{1}{2}$ " to 2" conduit (No. 7306). Also separate set of four punches for 2 $\frac{1}{2}$ ", 3", 3 $\frac{1}{2}$ ", 4" conduit (No. 7304). Knockout Punch No. 743 is available for 5" conduit.

GREENLEE TOOL CO., 1747 COLUMBIA AVE., ROCKFORD, ILLINOIS

NOW...GLOBE OFFERS...

two new **INTERCHANGEABLE** trays

for support of cables, wiring and tubing

- ★ Engineered for uniform design and easy installation
- ★ Steel or aluminum construction
- ★ Complete accessories for **SPEEDIER** installation
- ★ No sharp edges to damage cables
- ★ Complete interchangeability



Now, for the first time, two types of cable trays, one a ladder type and the other a basket type, are available to be used **INTERCHANGEABLY** at any given location, depending on the type and weight of the cables to be suspended. The advantages of each type tray can thus be used to the fullest extent. Globetrays, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is intended for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your **FREE** copy today.

Distributors are to be found in all principal cities—consult the yellow pages in your phone book under "Gratings" or "Conduits" for the one nearest you.



PRODUCTS DIVISION

The GLOBE Company MANUFACTURERS SINCE 1914

4032 SOUTH PRINCETON AVENUE, CHICAGO 9, ILLINOIS

Ballasts

(40)

A new line of mercury lamp ballasts with appropriate electrical circuits required by each lamp-type and input voltage condition. Three basic "Lamp Designed" types of circuits are used in the new mercury lamp ballasts. Designated LD-S, LD-R and LD-A, they are available in five basic construction designs. Stabilizing ballasts LD-S consists of an isolating transformer and a special circuit. The LD-R and LD-A circuits are furnished in either high or normal power factor designs and for either single lamp or two lamp operation. Two lamp designs of the lead-lag type provide power factor correction and reduction of stroboscopic effect.

General Electric Co., Schenectady 5, N. Y.

Transformers

(41)

Dry type Class B lighting transformers are now manufactured with Class F materials, suitable for 125°C rise above a 40°C ambient. Transformers are still designed as Class B, 80°C rise, and observe Class B limits. In addition to higher thermal resistance and greater overload capacity, they also feature lower decibel levels. Lighting transformers in 5, 7½ and 10 kva sizes can also be supplied in completely enclosed, dust-proof enclosures.

Marcus Transformer Company, Inc., Rahway, N. J.

Signal System

(42)

The Dial-In doctor's in and out system is built around a new device called the In-Former. It is intended for use primarily in hospitals having 100 or more staff and visiting doctors. The unit reveals to the telephone operator which doctors are in. The control rack for the device can be located anywhere convenient to the entrance register. The In-Former, when dialed by the operator, will disclose whether any doctor whose number she dialed has registered "In" on the entrance register. If he has done so a white "In" lamp will glow, if he has not an amber "Out" lamp will glow. In hospitals with more than one telephone operator each operator uses an In-Former, without interference.

Auth Electric Company, Inc., 34-20 45th St., Long Island City 1, N. Y.

Control

(43)

Stabiline Type EMT (Electro Mechanical Transistorized) automatic voltage regulators now have a completely transistorized control circuit that detects changes in output voltage and supplies correction voltage to the motor-driven power circuit. It is a compact assembly on a plug-in type chassis. Will operate in any position. Available in ratings from 2 to 100 kva for 115-, 230- or 460-volt, 50/60 cycle, single or 3-phase service. EMT series assemblies are especially for maintaining constant voltage to large industrial loads and as a means of obtaining a constant output voltage with zero waveform distortion. Bulletin S358EMT is available.

Superior Electric Co., Bristol, Conn.

Motors

(44)

A new line of self-lubricating electric motors. A supply of the proper type lubricant is contained in the visual reservoirs mounted on each motor end bell. Oil is retained in each reservoir by means of a mechanical stopper, permitting normal handling prior to installation without loss of lubricant from reservoir, and eliminating lubricant loss due to prolonged shelf life. Level is controlled by a built-in oil-level control tube. Motors are available as standard in $\frac{1}{3}$ to $1\frac{1}{2}$ hp ratings in 56-frame construction, dripproof, open or totally enclosed construction. Literature Form P-86017 is available.

Franklin Electric Co., Inc., Bluffton, Ind.

Loudspeakers

(45)

A new loudspeaking telephone for underground communication. Operating personnel can page each other over loudspeakers, then converse in natural voice tones to the desired person. The systems employ existing mine telephone lines and are designed to provide clear communication over heavily loaded, noisy or otherwise poor lines. Self-contained station units consist of an integral loudspeaker and telephone handset mounted on a dust-tight moisture-resistant wall case. A new transistorized transceiver, a dryer and two batteries are enclosed in the sheet metal housing. A switch on the front of the case permits selection of either of two groups for general paging.

Femco, Inc., Irwin, Pa.

Floodlights by Revere for every outdoor job

Revere Electric Manufacturing Co. produces a broad line of lighting equipment which includes a high quality floodlight for virtually any outdoor lighting application.

Revere floodlights are precision-engineered to achieve highest output combined with uniform light coverage. Dependable, easy-to-install Revere Floods are specially designed for easy re-lamping and cleaning. You can depend on Revere's long experience and sound engineering to solve your particular outdoor lighting problem.

Low cost, broad coverage

22-inch Eliptor floodlight is made of vitreous-fired porcelain enameled steel with choice of colors, or aluminum. Enameled steel model available with or without Alzak finished aluminum reflector. Inside of aluminum model has Alzak finish for best light projection. Wide range adjustments provide for accurate settings. Use 300 to 1500-watt incandescent or 400-watt mercury lamps. 3800 Series.



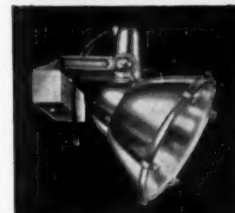
Small size aluminum floodlight,

12, 14 or 16-inch, is available either open or enclosed with clamp or hinge-type cover. Reflector is spun aluminum with etched Alzak finish for wide beam, polished Alzak for narrow beam. Housing is cast aluminum. Use incandescent lamps from 200 to 1000 watts. 7100 Series.



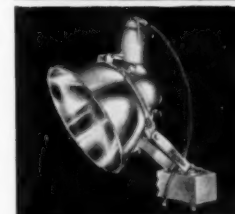
High power general purpose

18-inch floodlight for large areas. Wide or narrow beam Alzak aluminum reflectors. Hinged cover clamps to reflector for tight seal. 18-inch heat resisting lens available in plain, stippled or ribbed glass. Swing-over feature allows easy maintenance. Use 750, 1000 or 1500-watt incandescent or 400-watt mercury lamp. 4200 Series.



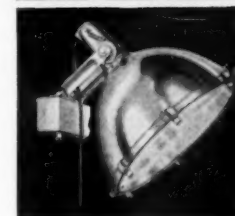
High power, rear service

18 or 20-inch floodlight has hinged rear reflector opening for safe, easy cleaning and relamping. Reflectors have Alzak specular or Alzak diffuse finish for narrow or wide beam. Front and rear sights enable accurate aiming of beam. Use 750, 1000 or 1500-watt incandescent lamps. 2000 Series.



Exceptionally high output

24-inch mercury floodlight for shopping centers, parking lots and other large areas. Alzak specular finish reflector for wide beam. Available with clamp or hinge-type lens holder with impact resisting lens. Fixture is weather-proof. Use 1000-watt 52,000 lumen mercury lamps. 7400 Series.



Send for Revere's complete catalog of outdoor lighting equipment

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ELECTRIC MFG. CO.

OUTDOOR LIGHTING

Revere Electric Manufacturing Co. • 7420 Lehigh, Chicago 31, Illinois
Available in Canada thru Curtis Lighting, Ltd., Leaside, Ontario, Canada



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1 Stock Wagner Standard Rotors to make more money ... give faster service!



When repairing a small Wagner motor, you'll save time and money by replacing the worn-out rotor with a Wagner Standard Rotor. This way, you keep those winders free for bigger, more profitable jobs. And your customers are pleased with faster service. Cash in on this short cut to profit by stocking Wagner Standard Rotors.

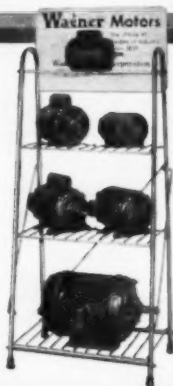
NO PROBLEMS WITH SPECIAL SHAFTS: Just remove the shaft from the Wagner Standard Rotor and replace it with the special shaft.

NO GUESSWORK IN FINDING THE RIGHT ROTOR: Wagner K and M "spec" lists, when used with the "tell-all" label on the rotor package, assure the right choice every time. The "spec" lists are in Catalog MU-40. Write for your personal copy today.



2 Build New Motor Sales with the Wagner Motor Merchandiser!

This 4-tier display stand puts an assortment of motors in full view of your customers... builds profits by helping your customers sell themselves. Sturdy, compact, chrome-plated. Just \$9.95 with your order for any 10 Wagner Motors in one lot. Contact your Wagner branch about this sales-builder today.



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MOTORS • BEARINGS • STANDARD ROTORS
BRUSHES • CAPACITORS • COMMUTATORS

OVER 850 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS

Lighting Fixture (46)

A new surface-mounted fluorescent lighting fixture using Holograph Primalume 6025 Controlens with illuminated sides of cream white ribbed polystyrene. Series DHI is 24 ins. wide in order to conform to ceiling tile lines. The Controlens are enclosed in 24-in. by 48-in. hinged frames, which can be lifted out for convenience in maintenance. Fixture is suitable for use in lobbies, executive offices, conference rooms, etc.

Leadlight Fixture Company, 800-100th Ave., Oakland, Calif.

Wireways and Fittings (47)

A complete line of liquid-tight "JIC" flanged hinged-latched-cover wireways and auxiliary fittings designed and built for use on wiring installations which require special protection against oil, dirt, dust and water. They are offered in four standard sizes—2½- by 2½-in., 4- by 4-in., 6- by 6-in. and 8- by 8-in.—all available in 1 through 5-ft lengths. Auxiliary fittings include T fittings and pull boxes, 90°, 45°, 22½°, and 7½° elbows; square and cross pull boxes, nipples and junction boxes. Reducing bushings, trough collars, gaskets, drop and bracket hangers and closing plates are also available in corresponding sizes. Catalog is available.

Keystone Manufacturing Co., 23328 Sherwood Rd., Warren, Mich.

Instrument (48)

A newly-designed version of an illumination control instrument which monitors light levels and signals a relay to switch lights on or off automatically. Designed Model 1099 luminaire illumination control, it features automatic positive operation of light switches without regard to time of day, temperature, or weather conditions. Unit is composed of a photronic light-gathering cell which continually monitors the light level and generates its own current, and a Sensitrol relay which is signaled to start the control and operate the load switch. Available in two types, either enclosed or uncovered, it can be equipped with an internal lightning arrester for maximum protection, and was designed for municipal and utility uses, as well as for general illumination signs.

Weston Instruments Div. of Daystrom Incorporated, Newark 12, N. J.

Floodlight

(49)

A new 120-volt floodlight lamp specially designed to withstand severe vibration. Built to take advantage of a new concept of mounting the filament on tungsten springs, the new PAR-38 lamp is for such applications as mine machinery, portable and movable construction and industrial equipment, and in mountings subject to wind vibration. The 150-watt lamp is made for 120-volt operation and has a medium skirted base. It will burn in any position.

Westinghouse Electric Corp.,
Box 2278, Pittsburgh, Pa.

Totally-Enclosed DC Motor (50)

Line of totally-enclosed motors with self-contained heat exchanger cooling for operation in highly contaminated atmospheres. Available in constant or adjustable speeds in frame sizes of EB-120 and up and in ratings from 10 through 200 hp, they are designed for machine tool, steel mill drive, paper mill, cement, and rubber plant applications as well as for use in other locations having airborne foreign matter. Motor's independent cooling system is unaffected by the speed of the motor and a thermostatic relay in the hot air stream at the commutator end shuts down the drive or operates an alarm in case of blower motor power failure. Heat exchanger unit can be removed for maintenance and removable gasketed covers permit accessibility to dc motor brushes and commutator. Bulletin 53B8904 available.

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

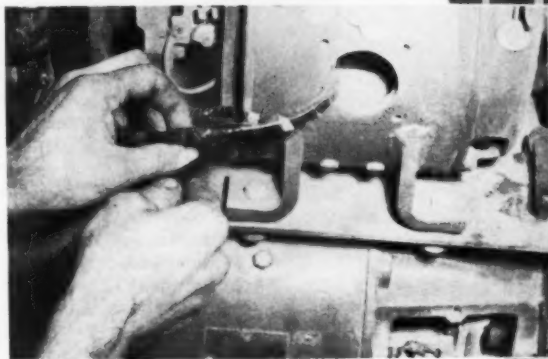
MV Fixture

(51)

A new Wide-Lite fixture makes possible the use of mercury vapor lamps for protective lighting in high-security outside areas. The light solves the low temperature problem through the use of two long-life (6,000 hours) incandescent lamps inside the weather-sealed floodlight fixture with the mv lamp. Incandescent lamps provide the instantaneous light needed, should low temperature delay the starting of the mv lamps; incandescents quickly heat the interior of the sealed fixture. Mercury lamps in the new lamp will operate in outside temperatures as low as minus 65°F.

Wide-Lite Corp., P. O. Box 191,
4114 Gulf Freeway, Houston,
Texas.

Shuford's NEW ELECTRICAL TAPE



SHURTAPE® EV-57

7 or 10 mil
Vinyl-Backed
Black or Yellow

Vinyl Pressure-Sensitive Tape

Here's a vinyl tape which combines desirable electrical characteristics with high resistance to oils, corrosive chemicals, humidity, fungus and mildew . . . conforms to irregular surfaces . . . works easily in limited areas.

Use it . . . to protect splices and connectors in power control leads.
Use it . . . to insulate high voltage motor leads. Use it . . . on bus bars . . . as pipe wrap . . . to insulate wires and splices in junction boxes and TV-Radio installations.

Use Shuford's SHURTAPE EV-57 wherever high dielectric strength, high insulation resistance, high stretch, high strength and excellent adhesion are required.



For complete information
write



Latrobe Electrical Products

Long Life

"Latrobe" Floor Boxes and Wiring Specialties offer real economy in installation and replacement costs. Their unique design, free of unnecessary parts, means quicker installation and longer service.



ADJUSTABLE FLOOR BOXES

Adjustable Floor Boxes are bonded which makes them fire-proof—come in single round or square bodies—also furnished in square single gang, two gang, three gang and four gang types.

Non-Adjustable Floor Box

Represents the last word in unique design, neat appearance, fewest number of parts, and least amount of labor to install.



Insulator Supports

Fasten porcelain or glass insulators to steel framework without punching holes. 4 sizes—1", 1½", 2" and 2½".

"Latrobe"

Pipe or Conduit Clamp

This clamp is made with a double safety bite of case hardened tool steel. Two models—Right Angle and the Parallel support. Each model comes in 10 sizes to handle pipe or conduit ½" thru 4".



Latrobe Products

Non-Adjustable Floor Boxes
Adjustable Floor Boxes
Gang Boxes—Cover Plates
Junction Boxes—Nozzles
Pipe or Conduit Hangers
Insulator Supports
Cable Supports—Fish Wire
Staple and Cable Clips

**Fullman
Manufacturing Co.**

1209-1215 JEFFERSON STREET
LATROBE, PA.

Hood Fan

(52)

New hood-fan for peninsular areas is equipped with Jet-Flo Fan. Standard 7-in. round duct is used for discharge through cabinets above the hood. Fan and light are operated from pushbutton control panel. It is available in three finishes: copper enamel, satin anodized aluminum, and copper anodized aluminum. Sizes: 36-in. and 42-in. lengths by 24½-in. deep.

NuTone, Inc., Cincinnati 27, Ohio.

Motor Base

(53)

Two new models of motor bases for maintaining the proper amount of tension in belts. Sizes range from ¼ to 500 hp. Tension is effected by a spring which also compensates for a considerable amount of belt stretch before any readjustment is necessary. When required, readjustment is made while operating underload by turning a screw. The pancake construction of bases makes them particularly adaptable to those applications where space is at a premium. They can be mounted in any position. Literature is available.

Automatic Motor Base Co., Windsor, N. J.

Product Briefs

(54) M.&W. Electric Mfg. Co., Inc., East Palestine, Ohio, has developed a **service entrance head** that fits all cable sizes from three No. 2 through three No. 4/0. . .

(55) Smaller Flexidyne drives and **couplings** have been added to the line made by the Dodge Manufacturing Corp., Mishawaka, Ind. . .

(56) Improved pulling arrangements are now incorporated in trolleys for use in 100-amp **trolley busway** electrification systems available from Feedrail Corp., New York, N.Y.

(57) Bronco 500 electrical hook-up and lead **wire**, insulated with teflon, with an operating temperature range of from minus 90°C to plus 250°C, impervious to chemicals and solvents, with zero moisture absorption, is the first of a line of high temperature wires to be announced by Western Insulated Wire Co., Los Angeles, Calif. . .

(58) Southwire Company, Carrollton, Ga., has announced five improvements in aluminum transmission **conductor**. . . (59) American Rectifier Corp., New York, N. Y., has developed a new line of **silicon rectifier** power supplies.

(60) Anaconda Wire & Cable

Co., New York, N. Y., has developed a new high-temperature **magnet wire**, called "Silotex-N". . . (61) ML-32 **step voltage regulators** manufactured by General Electric Co., Schenectady 5, N.Y., now incorporate a completely sealed tank and a redesigned tap changer switch for heavier duty. . . (62) New automatic commercial **garage door operator** is available from Lancaster Pump & Mfg. Co., Inc., Lancaster, Pa.

(63) Yale & Towne Manufacturing Co., Chrysler Bldg., New York, N. Y., has developed a new **key-operated plug** which guards against electrical hazards. . .

(64) The Rustrak **recorder** is a strip chart record produced by Rust Industrial Co., Manchester, N. H. . . (65) A new line of harmonic filtered voltage stabilizing **transformers** has been announced by the General Electric Co., Schenectady, N. Y.

(66) Complete-Reading Electric Co., Chicago Ill., has announced No. NV12 clear-thermosetting **varnish** available in 1-, 5- and 55-gal. containers. . . (67) "Vacation Watchman" is a special-purpose type of **time switch** added to the line of time controls manufactured by Reliance Automatic Lighting Co., Racine, Wis. . . (68) Eagle Electric Mfg. Co., Inc., Long Island City, N. Y., has introduced a new weatherproof **duplex receptacle** plate.

(69) A new 3,000-watt air-cooled Diesel electric **generating plant** has been announced by D. W. Onan & Sons Inc., Minneapolis, Minn. . .

(70) Anderson Electric Corp., Birmingham, Ala., has announced three new lines of one-center-bolt parallel-groove **connectors**, Series LC-50, LC-80 and LC-800. . . (71) A Fiberglass reinforced-polyester **tie-down ring** for large industrial motors and generators has been introduced by the Pittsburgh Electrical Insulation Co., Pittsburgh, Pa.

(72) Nu-Lite Corporation, Newark, N. J. has developed a new non-glare rough-service **incandescent lamp**, called Nilex. . . (73) A new line of **electric plants** has been introduced by Norseman Marine, Oshkosh, Wis. . . (74) A new high voltage bushing and **terminal assembly** is now being furnished by Wagner Electric Corp., St. Louis, Mo. on single and 3-phase distribution transformers.

(75) Tomic Sales and Engineering Company, Detroit, Mich., has introduced a new snap-on all purpose **fixture clip**.



VIBRATING BELLS
Cat. No. 2000



AC "CM" BUZZER
Cat. No. 284 MI



AC UNI-PACT HORNS
Cat. No. 123-U Two-Way
Projector



AC UNI-PACT HORNS
Cat. No. 121-U Megaphone
Projector



AC WEATHERPROOF
KODAIRE HORNS
Cat. No. 136



AC "CM" VIBRATING BELLS
Cat. No. ATL-700



DC BUZZER
Cat. No. 101



Compressor
Type
AIR TRUMPETS
Cat. No. 109-DC
Cat. No. 110-AC



UTILITY CHIME
Cat. No. 1531



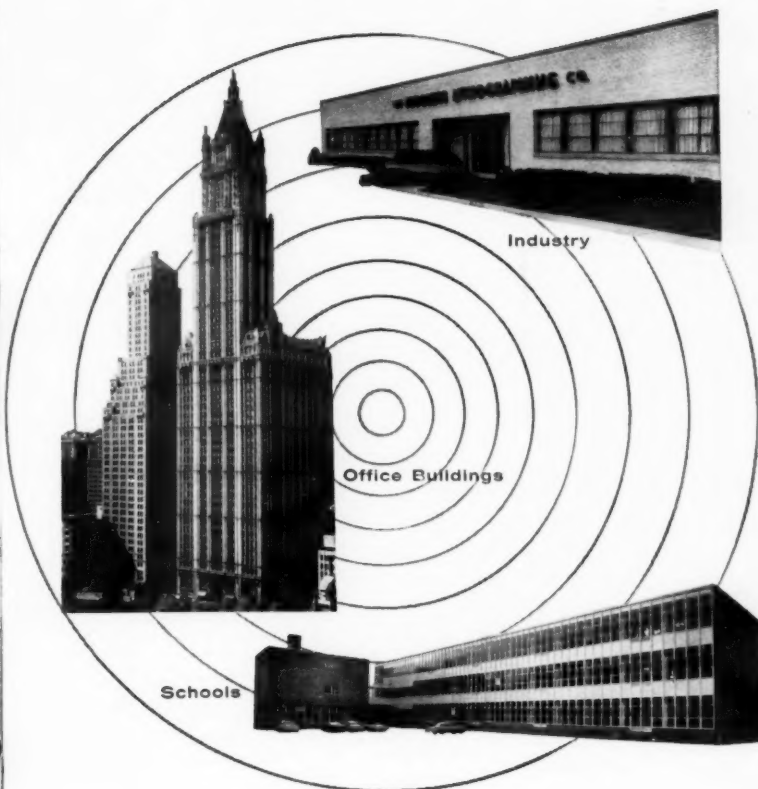
KODE MASTER
Page-Boy of your
Organization
Cat. No. 805



VISACALL
Closed Circuit TV For Super-
vision of Hospital Patients
Visacall-6



Specialists in: FIRE ALARM SYSTEMS • ELECTRICAL CLOCK SYSTEMS • HOSPITAL PATIENT OBSERVATION • CLOSED CIRCUIT TV • AUDIBLE SIGNALS • ANNUNCIATORS • CODED PAGING SYSTEM • SYNCHRONOUS CLOCKS • TRANSFORMERS • CONTACT DEVICES



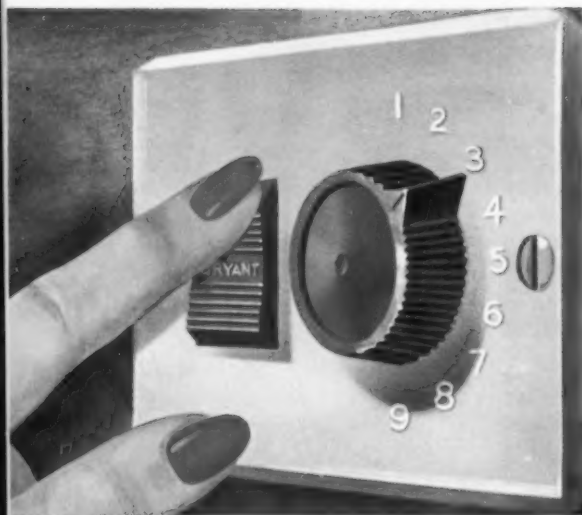
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*... a gentle chime ... a blasting horn ...
or a complete audio-visual communication system*

Sperti Faraday leads in the instant sound or sight communication systems that speed today's business or institutional contacts. Whatever your problem, whether simple or complicated our engineers are at your service to assist you in designing the system that suits your needs.

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**SINCE 1875 DESIGNERS AND PRODUCERS
OF VISUAL AND AUDIBLE SIGNALS
Adrian, Michigan**



EASY TO INSTALL

revolutionary low-voltage

BRYANT

brings you satisfied customers and extra profits

Multi-Control is easy to install. It puts more money into your pocket because it takes no longer to install than ordinary wiring systems. Contractors are making \$25 to \$75 extra profit installing Multi-Control in a home—and their customers are delighted with the results.

Multi-Control adds new convenience to electrical living. It's the most modern means of controlling lighting and appliance loads. Master Selector Switches permit control of numerous circuits from any point. Additional switches may be added as needed.

Your customers will take pride in owning this system . . . saves steps, saves time and makes for easy living.

On your next job, suggest Multi-Control. Once your customer understands what it is, he'll want it.

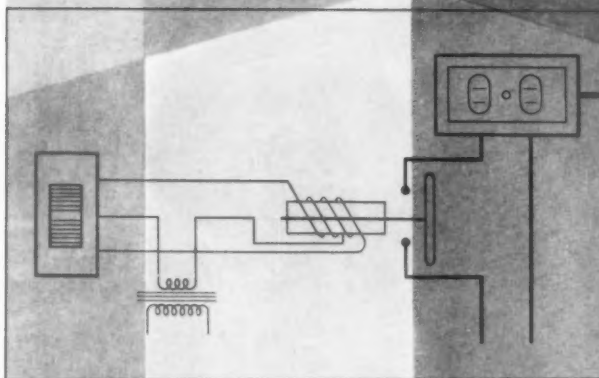
It's easy to sell—it's easy to install.

BRYANT

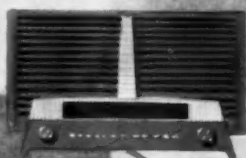
THE BRYANT ELECTRIC COMPANY
BRIDGEPORT 2, CONNECTICUT

how low-voltage Multi-Control system works

- A. Transformer supplies 24-volt current.
- B. Relay controls 125-volt current at outlet.
- C. Pushbutton switch (momentary contact) controls relay, thus outlet.
- D. Standard duplex convenience outlet.



MULTI-CONTROL



In the Home—controls desired outlets in every room in house, garage and grounds.



Commercial and Industrial Uses—controls lighting power and machinery at one or more central locations.



In Schools—controls hall and classroom lighting with lock-out circuit. Only the master's station retains control until lock out is released.



For Hospitals and Institutions—required by public buildings where control of lighting must be under strict supervision.

SPECIFY QUALITY ..

insist on *Levolier*[®] switches

Only **McGILL** makes
Levolier[®] switches

— and only Levolier switches give you the degree of quality that has earned them the reputation of being the most dependable switches ever built.

Material selected for extra quality includes heavy special alloy copper or silver for contacts and all switches are pre-lubricated with highly refined plastic petroleum. Completed switches are 100% factory tested and eliminate costly replacement.

Levolier switches are designed for fast, economical installation with self-insulating molded phenolic cases. .75 to 20 amps. All are Underwriters Laboratories Inspected.

No. 71 single-pole single circuit, universal pull lever switch . . . the thinnest 6 amp. "T", 125 volt—3 amp. 250 volt switch of its kind on the market today—only 15/32" thick. Also with push button.

No. 1010 single-pole, single circuit lever switch for high-watt lamps and fluorescent banks. Universal pull lever control. 10 amp. 125 volt.

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Catalogs & Bulletins

(76) **MERCURY LUMINAIRE.** Bulletin GEC-1491, 2 pages, describes Form 400 Power Pack luminaire, with photometric data and dimensions. General Electric Co.

(77) **LOW-VOLTAGE SWITCHES.** 2-page Form 210 describes new line of momentary contact switches in 1, 2, 3, 4 or 6-switch assemblies for remote control lighting system. Touch-Plate Mfg. Corp.

(78) **DECORATIVE LIGHTING** fixtures. New 40-page portfolio covers almost 100 designs ranging from contemporary to traditional with full color illustrations and complete specifications. Lightolier, Inc.

(79) **ELECTRIC HEATERS** for asphalt plants. Bulletin 995 illustrates and describes advantages of converting to electric heat to promote the smooth flow of asphalt in paving operations. Edwin L. Wiegand Co.

(80) **LIGHT BULBS**—how to judge them. New booklet contains numerous facts about light bulb life, light output, and cost. Westinghouse Electric Corp.

(81) **SERVICE STATION LIGHTING.** 4-page folder describes 9700 series fluorescent Island Lighter, plus accessory brackets and poles. Revere Electric Mfg. Co.

(82) **CAPACITOR MOTORS,** integral hp, single phase. 4-page folder 2401 describes and illustrates line of 1200, 1800 and 3600 rpm motors. Fairbanks-Morse.

(83) **RESIDENTIAL FIXTURES.** 1958 catalog includes contemporary and modern designs for every room in the home. Markel Electric Products, Inc.

(84) **LOAD CONTROL.** Electro-mechanical machine controls for specific industrial applications are described in 2-page bulletin AC-6. Tiptronic, Inc.

(85) **CONDULET** electrical equipment, floodlights, aviation lighting equipment, and traffic control equipment are described and pictured in new 12-page bulletin 2706. Crouse-Hinds Co.

(86) **THERMOSTAT.** 8-page bulletin gives complete information on four models of line-voltage thermostats for use with electric heating systems including single-line break, double-line break, modulating, and load-transfer thermostats. Mears Electric Controls.

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(87) DISTRIBUTION CUTOUPS. Two bulletins—511, covering open cut-outs, and 512, on open link cutouts—provide interrupting ratings in symmetrical current values to match ratings to actual short-circuit calculations. S & C Electric Co.

(88) SILICONE INSULATION. 8-page brochure 10-106 discusses both resinous and rubber-like systems of silicone insulation for repair of motors and transformers. Dow Corning Corp.

(89) CARTRIDGE HEATING UNITS and ceramic elements in full range of sizes from 1/4 in. diameter are described in 12-page catalog. Hot-watt, Inc.

(90) CONDUIT FITTINGS. 28-page catalog covers entire line of fittings and accessories, including new pressure cast EMT connectors and couplings. Conduit Fittings Corp.

(91) ANNUNCIATOR. New static-magnetic annunciator, using no relays, for automatic machine and continuous process operations. Bulletin 101, 4 pages. Panellit, Inc.

(92) ELECTRICAL CONNECTORS. New catalog describes complete line of electrical plugs and receptacles, cord grips and explosion-proof fittings. Ralco Mfg. Co.

(93) VARIABLE TRANSFORMERS. Powerstat line, continuously adjustable, for 120, 240 or 480-volt, single- or 3-phase duty. Data sheet SE-L2583. Superior Electric Co.

(94) HAZARD WARNING equipment for highways, including portable lanterns, torches and electronic flashers, is treated in new comprehensive manual. Hazard Warning Lighting Div., R. E. Dietz Co.

(95) INSULATING MATERIALS. Bulletin GER-1467, 12 pages, describes characteristics and application range of materials for use in specifying compatible materials for electrical insulation systems. General Electric Co.

(96) FLUORESCENT EQUIPMENT. Catalog provides full details on construction and installation of troffers, geometrics, commercials, and industrials. Good Mfg. Co.

(97) BATTERY ACTIVATION method which allows primary batteries to be activated and operated in any position is described in new bulletin. Yardney Electric Corp.

(98) CIRCUIT BREAKERS. 16-page bulletin SD-100 covers type QO breakers for institutional, residential, commercial and industrial applications. Square D Co.

(99) DISTRIBUTION TRANSFORMERS. GEA-6070C, 24 pages, outlines features of pole-type transformers, their design, construction and packaging. General Electric Co.

(100) FIRE ALARM SYSTEMS. Bulletin 131, 26 pages, covers complete line of coded and non-coded systems, control panels, stations, detectors and testing devices, with complete sample specifications for each system and a glossary of fire alarm equipment terms. S. H. Couch Co., Inc.

(101) ELECTRIC HEATING ELEMENTS. New data sheet contains complete details and specifications on flat, sinuated wire elements. Syntron Co.

(102) MASTER SWITCH CONTROL. Bulletin 5701A presents design features and engineering data on complete line of master switches for control of hoists, cranes, or other equipment using wound rotor or dc motors. Furnas Electric Co.

(103) TROLLEY BUSWAY electrical distribution systems rated at 225, 375 and 500 amps for electrification of heavy duty cranes and hoists, machine tools, conveyors and other moving equipment are described in new bulletin 70. Feedrail Corp.

(104) INDUCTION HEATING at 400 cycles, operated by strip chart program controller, is covered by folder DM-74. Hobart Brothers Co.

(105) SUBSTATION-TYPE REGULATOR. Bulletin GEC-1489, 4 pages, describes regulators for series street lighting circuits, together with wiring diagrams. General Electric Co.

(106) FLUORESCENT FLOODLIGHTS for highway guide signs, service stations, building fronts, sports areas, loading docks, and other applications. Bulletin GEC-1487, 4 pages. General Electric Co.

(107) POWER PACKAGE for starting standby power engines includes silicon charger and lead-calcium batteries. Bulletin AR-101/58. C & D Batteries, Inc.

(108) AC MOTORS. Bulletin SP-1 gives uses and characteristics of motors in ratings from $\frac{1}{2}$ to 10 hp in drip-proof and totally enclosed design. Peerless Electric Co.

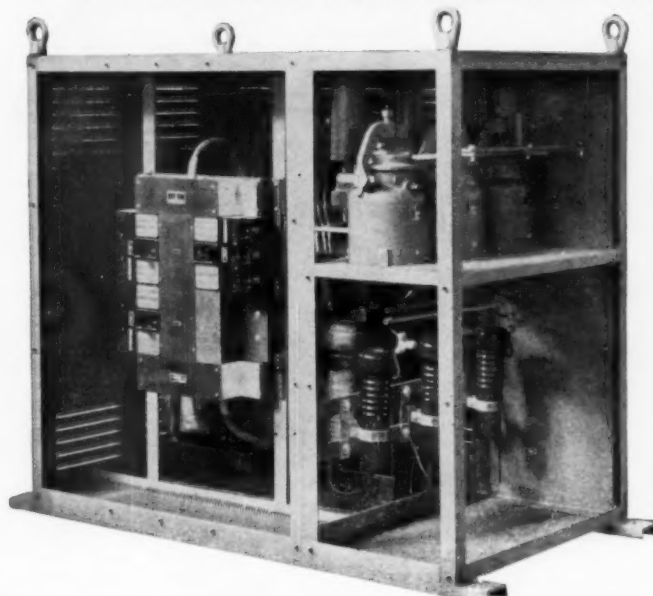
(109) POWER OUTLETS for mobile home parks, outdoor construction, or farm and ranch use. Complete line is described in new folder. Hoffman Engineering Corp.

(110) GENERAL-PURPOSE FLOODLIGHT. Bulletin GEC-1488, 2 pages, describes 1500-watt floods with dimensions and mounting accessories. General Electric Co.

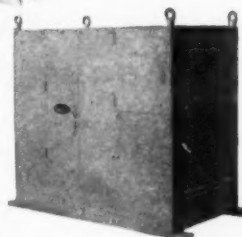


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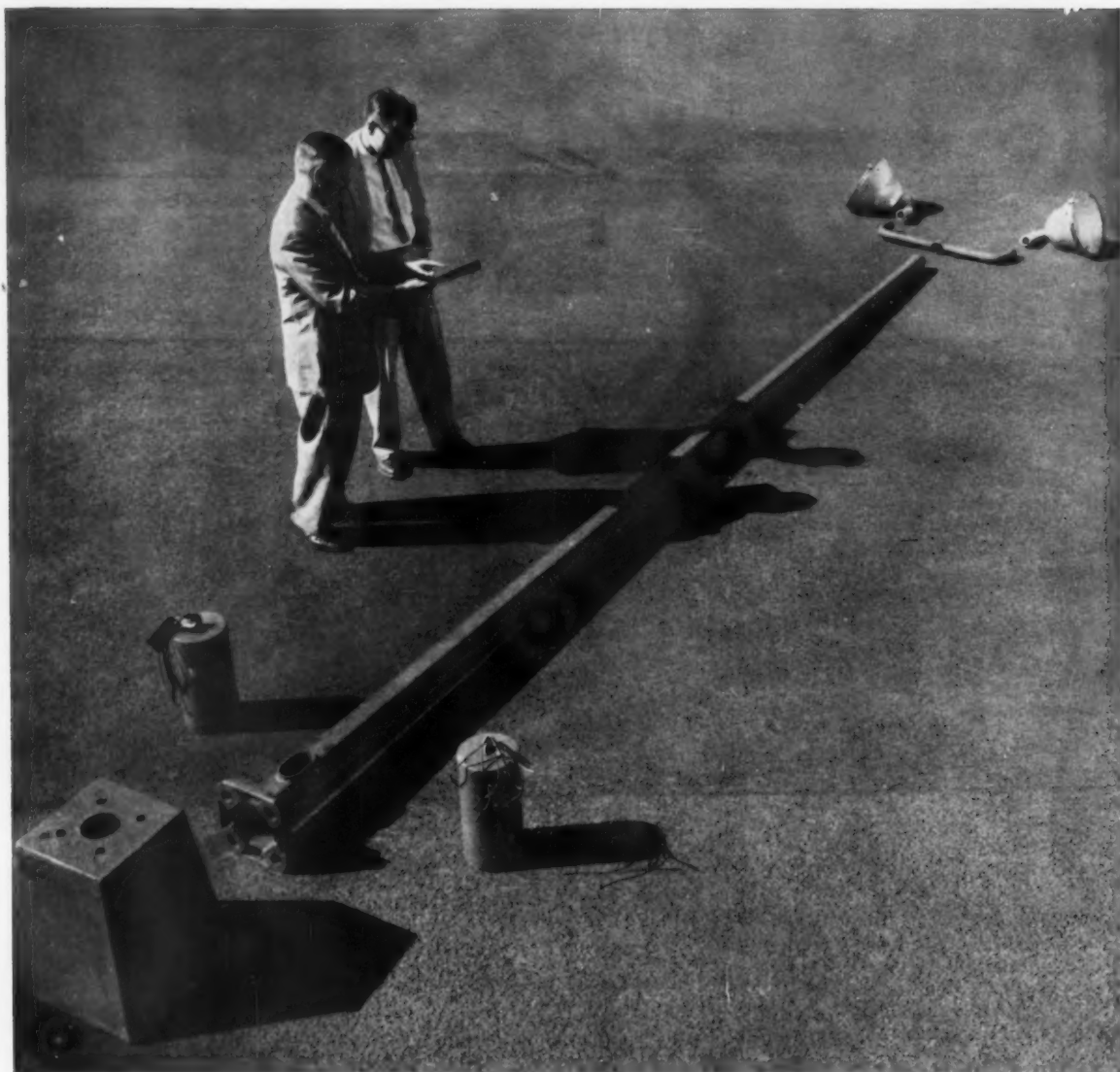
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Revere's complete line of matched equipment means peak efficiency and easy installation

Shown above are the components of a Revere outdoor lighting installation. Every component — pole, base, bracket, lights — is *perfectly matched* to every other component, so the completed installation is exactly right for the job. Components "fit" right to make installation easy, they are structurally matched for strength and balance, and "design-matched" to give peak lighting efficiency for the application.

Revere offers the widest selection of outdoor lighting equipment available from any single source. You can get on-time delivery of Revere fixtures for incandescent, mercury or fluorescent lighting, as well as hinged, rigid, separable poles and accessories. Ask your wholesaler about the advantages of specifying Revere equipment.

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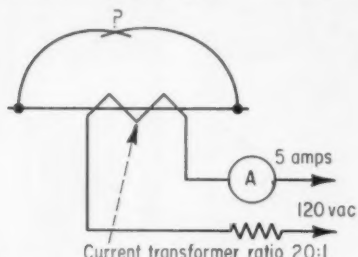
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Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay \$5.00.

Load Effects in Current Transformer

QUESTION E34—If I send 5 amps through the secondary of a current transformer, will 100 amps flow through the primary circuit if it is shorted? (Ratio of current trans-



former 20 to 1.) Suppose a load of 10 ohms is connected to the primary. What happens to the current and voltage?—H.G.R.

ANSWER TO E34—The operation of any transformer depends upon two factors, the first being the flux density in the core and the second being the ratio of transformation.

In Question E34, the problem was raised regarding a 20/1 current transformer where the rating on the transformer was 100 amps to 5 amps. From this, we can see that the ratio of turns will be 1/20 with one turn on the primary and 20 turns on the secondary.

If a voltage is applied to the secondary of this current transformer, a current will flow. This current depends upon the characteristics of the steel. In general the current will be quite small but will rise very rapidly as soon as the saturation point of the iron is reached. When the iron is completely saturated, the magnetizing current will be extremely large.

Current transformers are used at low flux density. This means at relatively low voltage across the winding. What happens then is the following. As soon as a voltage is applied across the winding, a small current flows and this in turn establishes a flux through the core. If the other winding of the transformer is short circuited, then a voltage will be developed in this other winding which in turn will generate a circulating current. This current will oppose the first one and the resultant magnetizing effect

will be virtually nil as only a very small flux is needed in the core of the transformer to maintain the transformation. Under these circumstances, the ratio of transformation will be directly as the turns ratio inasmuch as the ampere turns on one side will equal the ampere turns on the other. Therefore, in the event that the primary of the given transformer was short circuited and a current of 5 amps was circulated through the secondary, a current of 100 amps will flow in the primary.

The situation is radically different when a load of 10 ohms is connected to the primary. Under these circumstances, a circulating current cannot flow readily through the winding. If one attempts to push 5 amps through the secondary of the transformer, one will find that one needs an excessively high voltage to do so. In fact the iron will saturate. The iron of the current transformer will not be capable of delivering sufficient flux to the primary winding to develop the voltage required. In the case cited where the primary has a load of 10 ohms, the primary current of 100 amps will require a primary voltage of 1000 volts. In general, the current transformer will not be designed to deliver such a high voltage into the winding.

I would point out that certain types of relay transformers are designed to carry high voltages momentarily. This is however an unusual case but I would refer the questioner to the American Standards Association booklet on relay transformers which are a different breed of cats from the standard current transformers.—H.H.S.

ANSWER TO E34—Operation of a current transformer is characterized by its "burden" in volt-amps or in ohms. Suppose the permissible burden is 5 volt-amps. For a secondary current of 5 amps the permissible secondary voltage is 1 volt and the maximum permissible

$$\text{burden} = \frac{1 \text{ volt}}{5 \text{ amps}} = 0.2 \text{ ohm. If the}$$

current transformer is energized from the secondary side, the same volt-amp burden limitation governs. For a primary current of 100 amps, the maximum permissible primary

voltage is $\frac{5 \text{ VA}}{100 \text{ A}} = 0.05 \text{ volt}$ hence the maximum permissible primary

$$\text{burden} = \frac{0.05 \text{ volts}}{100 \text{ amps}} = 0.0005 \text{ ohm or}$$

0.5 milliohm. If the primary burden is 10 ohms instead, the power would be $I^2 R = 100 \times 100 \times 10 = 100,000 \text{ watts or } 10 \text{ kw}$, the primary voltage would be 1000 volts, the secondary voltage 20,000 volts. The current transformer would be destroyed by electrical as well as thermal breakdown. However, one can operate it in reverse if the primary short-circuit resistance does not exceed 0.5 milliohm.—L.F.R.

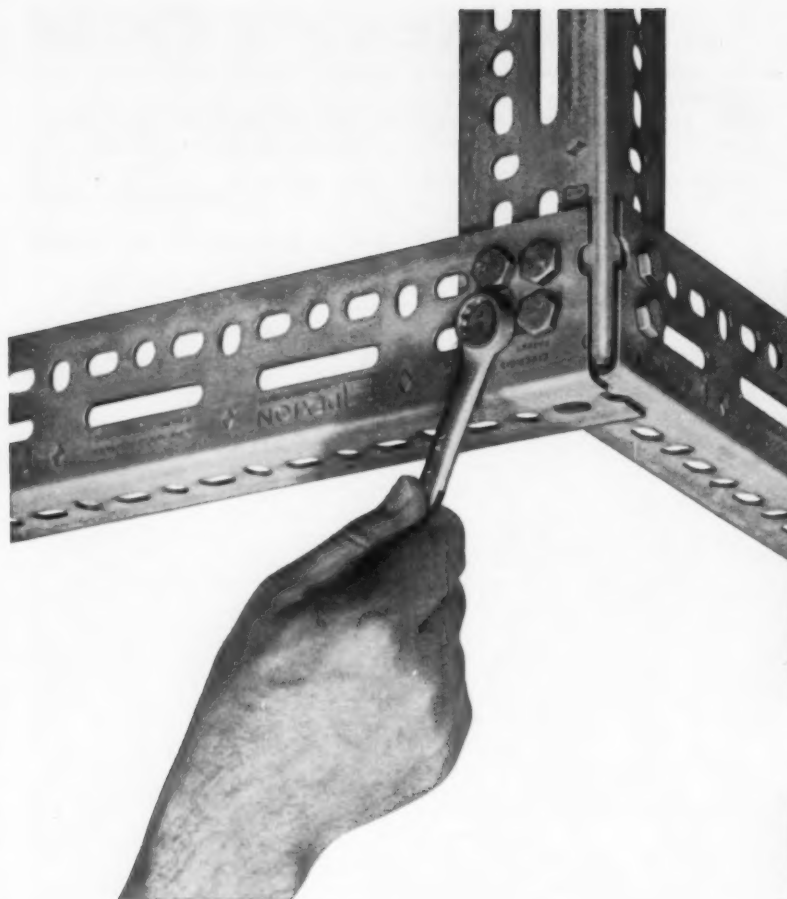
ANSWER TO E34—This current transformer, CT, is rated 5-amp full load and generates 120 volts in secondary. Instrument transformers in general and CT's in particular are made with generous iron in the core so they work on the straight part of the iron's BH or magnization curve, where a small increase in amps greatly increases flux. The basic principle of a CT is the same as that of the ordinary voltage transformer:

$$\frac{V_p}{V_s} = \frac{T_p}{T_s} = \frac{I_s}{I_p}$$

However, in the CT the primary volts are a small fraction of line volts and the primary impedance Z_p has but little effect on the primary current which is almost entirely determined by the motor or load being fed. As secondary impedance Z_s is fixed by the instrument and leads, Z_p is fixed and V_p varies as I_p from $V_p = Z_p I_p$. Likewise V_s varies with I_p and hence I_s varies directly with I_p . Thus it transforms current in a constant ratio

$$\text{which is } \frac{I_s}{I_p} = \frac{T_p}{T_s}$$

Most of V_s is dropped in the secondary coil. The instrument impedance or "burden" is quite small: 0.1 to 0.5 ohms. The flux of I_s is opposed to a large extent by that of I_p , leaving enough flux, as determined by the designer, to generate the required V_s to force I_s through Z_s . If Z_s is increased slightly it would tend to decrease I_s and its flux. Since I_p is determined by the load demand, the increase in net flux raises V_s enough to increase I_s .



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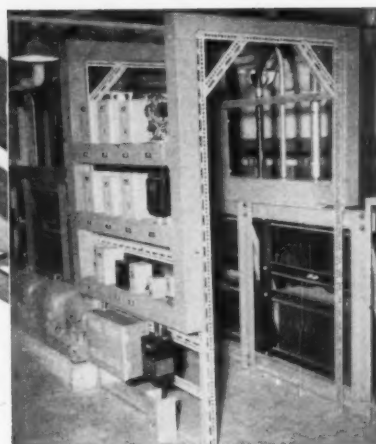
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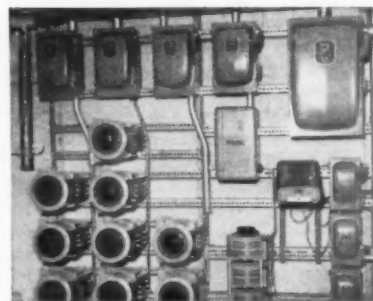
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back to where it was. There is a slight increase in Z_p and voltage drop across primary or V_p , but this is tiny compared with total line drop in load, etc. If the secondary were opened with primary current I_p flowing, no I_s would flow, net flux would be very high, V_s would be very high and might puncture the secondary turns insulation. This is why a hot CT should have a load or a short on its secondary.

Now for HGR's question: with 120 volts or rated V_s applied to the secondary thru its usual Z_s or instrument load, 5 amps would flow in the secondary, 100 amps would flow in *shorted* primary. If 10 ohms were inserted in the primary, the new I_p of this $\frac{20}{1}$ ratio CT would drop in this ratio

$$\frac{I_{p \text{ new}}}{I_{p \text{ standard}}} = \frac{Z_{p \text{ standard}}}{Z_{p \text{ std}} + 10 \text{ ohms}}$$

As Z_s is very low the new I_p would drop to a very small part of 100 amps.—R.W.K.

Fan Speed vs Drive HP

QUESTION F34—A 5-hp motor drove a fan at 600 rpm. We decided to increase air circulation by driving the fan at 700 rpm. Motor temperature indicated that it was delivering only about 4 hp, but when we stepped up to 700 rpm, the motor heated as if it were very much overloaded. Why?—G.J.P.

ANSWER TO F34—The theory of a centrifugal fan is almost identical with that of the centrifugal pump because the variation of the density of air within it is negligible. Consequently, the characteristics of the centrifugal pump are similar to those of the centrifugal fan. Assuming the 60% to 70% efficiency of the centrifugal fan to remain constant in a given case, the following relations hold:

$$\begin{aligned} Q &\text{ varies as } n \\ h &\text{ varies as } n^2 \\ P &\text{ varies as } n^3 \end{aligned}$$

where Q = Capacity of fan in volume/unit time, usually cu. ft./minute,

h = Static or impact fan pressure, usually in inches of water or ounces per square inch,

P = Power in the air delivered by the fan, in horsepower,

n = Fan speed, in revolutions per minute.

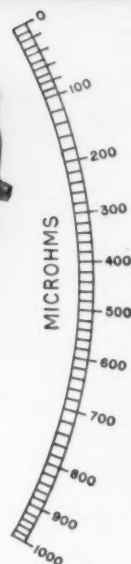
In the case under consideration:

$$P = 4 \left(\frac{700}{600} \right)^3 = 6.35 \text{ horsepower}$$

required at 700 rpm, overloading

New

MEGGER® LOW RESISTANCE OHMMETER



RANGES

0 to 1,000 microhms
0 to 10,000 microhms
0 to 100,000 microhms
0 to 1 ohm

- Completely Self-Contained
- Convenient, One-Man Operation
- Battery or Rectifier-Operated Models

The new Megger Low Resistance Ohmmeter is a direct-reading instrument of sturdy, compact design. Has wide application in electrical maintenance for resistance measurements of electrical conductors, joints, contacts and windings of the low resistance type in oil circuit breaker assemblies, rotating electrical equipment, transformer and coils. This instrument is also most useful for controlling manufacturing and assembly processes which include identification and classification, in terms of resistance, of metal and metal alloy components.

IDEAL FOR FIELD OR BENCH USE

Two models of the Megger Low Resistance Ohmmeter are available. One has a battery power supply for field use. The other has a rectifier which can be plugged into any ordinary lighting circuit outlet for bench use. Each is equipped with automatic quick-acting circuit-breaker.

FEATURES

1. Measures accurately to 10 microhms
2. Open, easy-to-read, $3\frac{1}{4}$ " scale
3. 4 ranges: In addition to the x1 position on the selector switch it multiplies scale x10, x100 and x1000
4. Small size—13" x 6" x 7"
5. Light weight—only 10 pounds
6. Sturdy carrying case keeps instrument, leads and prods in one place, ready for use.

NEW CLAMP DESIGN ON TEST LEADS

Special clamp type test leads 18 feet long are available on special order. The extra length facilitates tests in elevated or remote locations without moving the instrument close by. Especially important in testing large circuit breakers. Clamps are of duplex type, each makes current and potential connection when applied. This permits one man to make tests.

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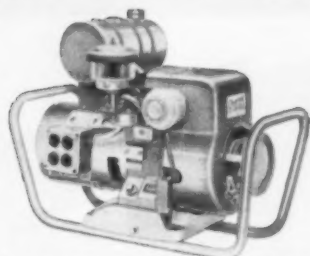
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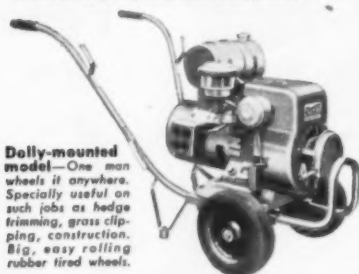
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New 1500 watt D.C. Onan Electric Plant

Here's more efficient portable power for all 115-volt D.C. and universal motors or tools and equipment. This new Onan power package, Model 115AK-115M, gives you more power per pound of electric plant, more power per gallon of gasoline. Recommended specially for turf maintenance, emergency rescue service, and fire department use.

Direct-connected, compact design

Rugged, single-cylinder, 4-cycle, Onan air-cooled engine starts quickly in any weather. Heavy-duty splash-proof generator is direct-connected to engine, making a rigid, compact, long-life unit. Standard equipment includes manual starter, oil-bath air cleaner and 4 plug-in receptacles. Carrying frame, 2-wheel dolly and recoil starter are optional at low cost.



Standard Model For installation in maintenance trucks, on fire rigs etc. Converts to portable model with carrying frame or dolly.

See your Onan distributor
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D.W. ONAN & SONS INC.

2800A University Avenue S. E.
Minneapolis 14, Minnesota

the 5-hp motor. If it is desired to utilize the available 5 hp of the motor, the fan should not be driven above,

$$n = 600 \sqrt{\frac{5}{4}} = 645 \text{ rpm.}$$

—R.G.C.

ANSWER TO F34—Whether or not the motor would be overloaded when the fan speed was raised from 600 rpm to 700 rpm depends on the load characteristics of the fan. A typical fan may, however, have a characteristic in which the horsepower requirements are proportional to the cube of speed at which the fan runs, and in all probability, this is the type of fan under consideration. Thus, if the speed is changed from 600 to 700 rpm, the horsepower requirement to drive it is increased by the ratio of $(700/600)$ cubed or 1.59. If the requirements at 600 rpm were 4 hp, the requirements at 700 rpm would be $4.0 \times 1.59 = 6.35$ hp. It would be expected then, that such a load would cause a 5-hp motor to overheat.

From the above relationship, calculations will show the maximum speed at which the assumed type of fan may be run without exceeding motor rating. It must be kept in mind, however, that the load on the motor depends on the load characteristics of the fan actually in quest.—W.C.H.

Phase Shift In Delta-Wye

QUESTION G34—Will you kindly explain with the use of vectors the reason for the phase shift between two feeders supplied by delta-wye transformers connected to the same source on the high side.

This shift occurs when the phase rotation is changed on both the high and low side of one of the 3-phase transformers.—A.T.K.

ANSWER TO G34—The key to understanding the answer to this question is the vector relationships in a two winding single-phase transformer. At any instant the voltage induced in the secondary is 180 degrees opposed to the voltage applied to the primary. (Fig. 1).

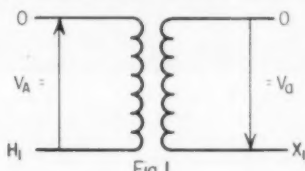
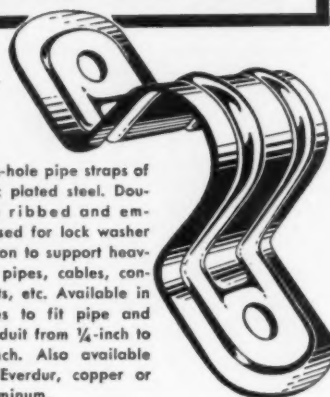


Fig. 1

MINERALLAC 2-HOLE PIPE STRAPS

For Heavier Loads!



Two-hole pipe straps of zinc plated steel. Double ribbed and embossed for lock washer action to support heavier pipes, cables, conduits, etc. Available in sizes to fit pipe and conduit from 1/4-inch to 6-inch. Also available in Everdur, copper or aluminum.

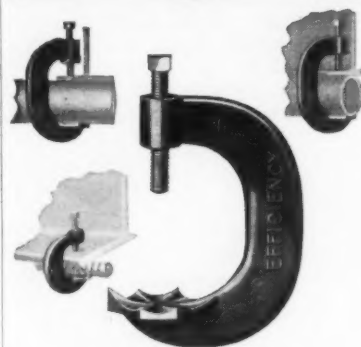
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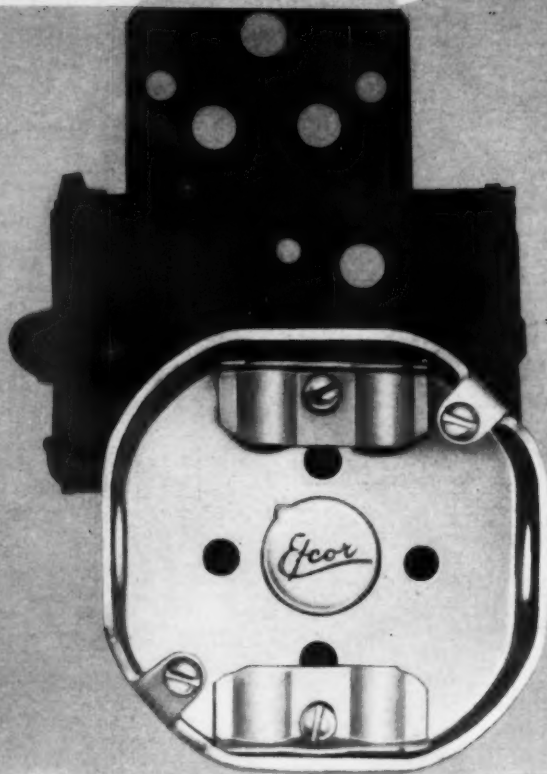


On Steel Construction, "Type F" hangers are best for carrying 1/2 to 2 1/2 pipe and armored cable at any angle to beams.

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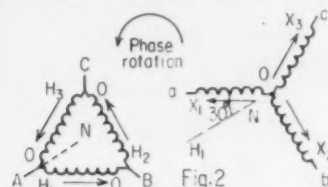
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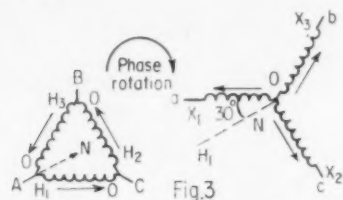


Write for
BULLETIN 131
S. H. COUCH COMPANY, INC.
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If three of these single phase units are connected in delta on the primary and wye on the secondary, and connected to the power source so the phase rotation is ABC, the resultant voltages in the secondary will be as shown in Fig. 2.



If the phases of the primary and secondary are reversed by interchanging the B and C connections, the voltages will be as shown in Fig. 3.



A 3-phase transformer is comprised electrically of three single-phase units, so this reasoning is valid. In the figures above the primary line to neutral voltage has been shown as a dashed line designated H_1-N . This voltage is displaced from the secondary line to neutral voltage X_1-O by 30 degrees. This displacement is due to both winding H_1-O and X_1-O being on the same core, while one is a line-to-line voltage and the other is a line-to-neutral voltage.

In Fig. 2 with ABC phase rotation, H_1-N leads X_1-O by 30 degrees. In Fig. 3 with ACB phase rotation, H_1-N lags X_1-O by 30 degrees. This is the phase shift that is referred to in the question and it would prevent the paralleling of these two 3-phase transformers.—L.D.B.

Explosion-Proof Sealing Compound

QUESTION H34—What type of powder is used to seal explosion-proof fittings?—H.S.

ANSWER TO H34—The powder used to seal explosion-proof conduit fittings is a special compound that when mixed according to directions will expand and harden. This expansion characteristic forms an impervious seal around the wires and the body of the sealing fitting. The hardened compound is not affected by gasoline, alcohol or other sol-

vents and will withstand the effects of an explosion.

The Underwriters' Laboratories lists the conduit fittings for sealing for use only with the respective manufacturers' sealing compound. —A.W.C.

ANSWER TO H34—The National Electrical Code answers this quite adequately. I've never had any manufacturer give an analysis of his compound. Either Crouse-Hinds or Appleton will supply the compound. However, in a dire pinch, straight Portland cement works good. I only recommend Portland cement when you are several thousand miles from a supplier of regular compound and must seal immediately. —W.E.G.

Can You Answer These QUESTIONS

QUESTION S34—In the mill where I am employed one of my responsibilities is to keep all hand lanterns and flashlights in good working condition. The greatest difficulty is to try and make ends meet on a limited budget because the cost of flashlights and other dry batteries are too high. Can someone tell me of a good rechargeable battery that is small enough to be practical for flashlights and hand lanterns? I saw an article in a leading magazine that stated it was possible to recharge a standard dry type battery. Is this practical?—M.D.

QUESTION T34—Is it possible to rewind a 250-hp, 220-volt, 3-phase, 60-cycle squirrel cage induction motor for 4160-volts? If so, what will the new horsepower rating be?

What determines if a 220-volt motor can be rewound for 4160?

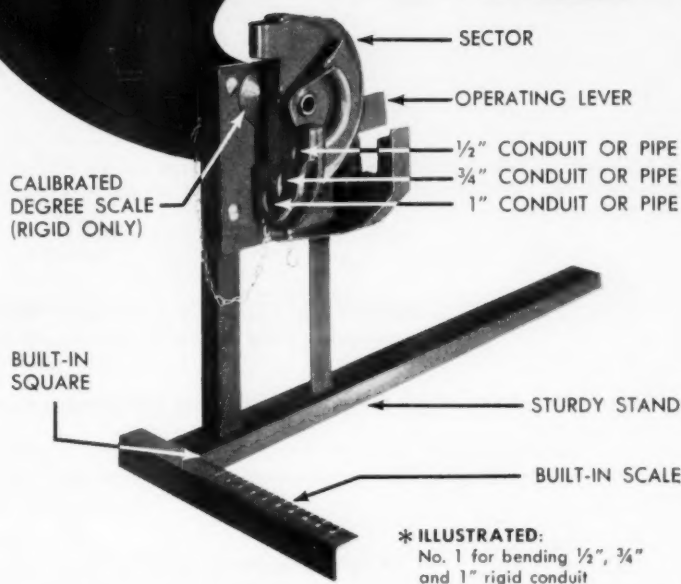
Finally, is it more economical to rewind the above motor to release 250 kva of secondary power than it is to purchase 250-kva transformers for 4160/220 volts?—J.A.M.

QUESTION U34—Could someone explain the reason for the very noticeable flicker in many of the fluorescent lamps in a relatively new installation? I have been told that this is not "flicker" but rather a "swirl". Is there any way of correcting it?—I.G.B.

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1" conduit or pipe	5 3/4"	EMT 6 1/2"
	No. 2	No. 2T
1 1/4" conduit or pipe	7 1/4"	EMT 9 1/2"
1 1/2" conduit or pipe	8 3/4"	EMT 10 1/2"

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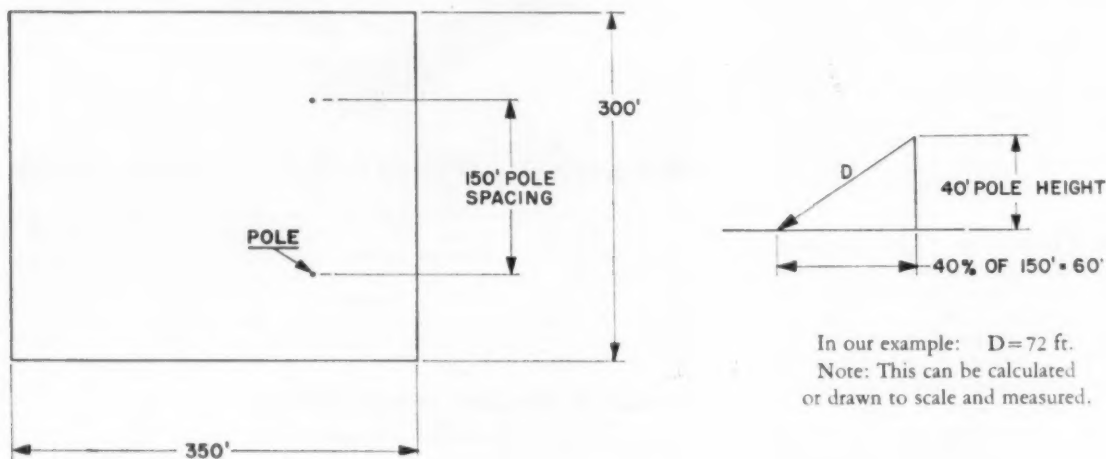
How to Estimate Floodlighting Requirements

(Short Cut Method)

The following is a brief method for estimating the size, type and quantity of floodlights to light a given area. The results are approximate, and the system is not fool-proof. However, it presents a method of very rapidly estimating the cost of floodlights to do the job.

Example: It is desired to light a parking area 300 ft. by 350 ft. to an average level of 1.0 maintained footcandles, using color improved mercury vapor lamps.

- (1) Assume that the area is such that it is decided to use 40-ft. poles as shown below.



- (2) Determine "D" which is the length of the center-line of the beam, in feet.
Note: Normally, horizontal distance can usually be estimated as 40% of the pole spacing.

ESTIMATING HINTS: When spacing the location of floodlight poles, the ratio of height to distance apart should not exceed a ratio of 1 to 4. Example: 40-ft. pole height—spacing 160 ft. maximum. When spacing floodlights on buildings or on the ground, the spacing should not exceed a ratio of 1 to 1½. Example: floodlights 4 ft. from building or sign should be spaced not more than 6 ft. apart.

- (3) Determine footcandles (F) from Table 1, from other tables of recommended values, or according to personal desires.
In our example: F = 1.0

Courtesy The Pyle-National Company, Chicago, Ill.

TABLE 1. CURRENT RECOMMENDED PRACTICE — FOOTCANDLES

BUILDINGS				MISCELLANEOUS	
Building Surfaces	Reflec-tion Factors Per Cent	Recommended Foot-Candle Levels*			Recommended Foot-Candle Levels
White terra cotta	60-80	15	10	5	1-2
Cream terra cotta					
Light marble					
Light-gray limestone	40-60	20	12	7	50
Bedford limestone					100
Buff limestone					
Smooth buff face brick	20-40	25	15	10	20
Briar hill sandstone					50
Smooth gray brick					5
Medium-gray limestone	10-20	30	18	12	2
Common tan brick					5
Dark-field-gray brick					0.2
Common red brick					2
Brownstone					1
					0.2

*A—Buildings on white ways; intensive street lighting; streets with many conflicting signs and light sources; lower portions of buildings falling under Class B locations.
 *B—Medium-intensity white ways; secondary business streets with few conflicting signs, etc.
 *C—Very little conflicting light, such as on residential streets, parks, lighted highways, etc.

Service Stations	Recommended Foot-Candle Levels
Buildings	See Table Above
Parking Areas	1
Pump Areas	20
Yards and Driveways	5

RAILROADS		Footcandle levels are average maintained values on horizontal plane. Values should be at least double on vertical planes.
Classification Yard	General	0.1 to 0.2
	Hump	0.5 Min.
	Retarder Areas	2.0 - 3.0
	Retarders	2.0 - 5.0
	Departure Yard	0.06 to 0.2
	Lead-in and Lead-out Tracks	0.2 - 0.3
	Receiving Yard	0.1 - 0.3
	Repair Track	1.0 Min.
	(Light Running Repairs)	

- (4) Use these values of F and D in the following table to determine the beam candlepower (BCP) needed in the floodlight.

Note: If F is on a horizontal surface, such as the ground, which is the usual case, use the right hand column. If the illuminated surface is normal to the beam, such as a billboard or building front, use the left hand column.

Distance Classification	Within Distances Given (D)	B.C.P. Required for "F" Normal to Floodlight Beam	B.C.P. Required for "F" on Horizontal Plane. Lighting from one Direction Only
Short Range	50' to 150'	$D^2 \times F = \text{B.C.P.}$	$D^2 \times F \times 2 = \text{B.C.P.}$
Med. Range	150' to 300'	$D^2 \times F = \text{B.C.P.}$	$D^2 \times F \times 3 = \text{B.C.P.}$
Long Range	300' to 700'	$D^2 \times F = \text{B.C.P.}$	$D^2 \times F \times 4 = \text{B.C.P.}$

Where F = Footcandles, D = Distance from floodlight to where center of beam strikes ground, BCP = Beam Candlepower.

In our example: the illuminated surface is the ground, so the right hand column is used, and length D of 72 ft. falls within the "short range" limits.

$$\text{Therefore: } \text{BCP} = D^2 \times F \times 2 = 5200 \times 1.0 \times 2 = 10,400$$

- (5) From lamp specification data, select the largest floodlight with this beam candlepower (BCP).

Note: It is desirable to find the largest wattage bulb to give this BCP and then determine the smallest size floodlight which will use this wattage lamp and still maintain BCP. When seeking calculated BCP in the specs, use values in a range from the calculated values to about 10% higher than the calculated value.

For our example, the calculated BCP is 10,400. Therefore, we will look for the largest floodlight with a BCP between about 10,000 and 11,500. Assume this turns out to be a floodlight with a specular reflector, wide-spread lens, and using a 700-w mercury vapor lamp, with a unit BCP of 10,700.

- (6) Select a utilization factor (U) from Table 2 for the type of area being illuminated.

We will use a (U) of 10.5 for our example.

TABLE 2. FLOODLIGHTING APPLICATIONS

	Utilization Factor—"U"
Large Parking Lots, Construction Work, Large General Areas	10.0 - 13.0
Gas Stations, Small Parking Lots	8.5 - 10.5
Buildings, Sign Boards, Monuments, Etc. Short or Medium Range	7.0 - 8.0
Buildings, Sign Boards, Monuments, Smokestacks—Long Range, Narrow or Small Areas	5.0 - 7.0
Protective Lighting—Fence Areas, Entrances, Walkways, Roads	5.0 - 7.0
Loading Docks	6.0 - 8.0
Railroad Yards, Classification or Hump	6.0 - 7.0

APPLICATION	Utilization	Factor "U"
For Extra Large Areas—All or Majority of Beam Projected on Area	Extra High	14 - 15
Large Area Lighting—Normal Job	High	10 - 13
Average Lighting Applications—Short and Medium Range	Medium	7 - 9
Small or Narrow Areas—Long Range	Low	4 - 6

- (7) Determine total number of floodlights required by the formula:

$$N = \frac{F \times A}{U \times W}$$

where: F is obtained in step 3

U is obtained in step 6

A is the area in square feet

W is the wattage of the bulb in the floodlight determined in step 5

For our example:

$$F = 1.0$$

$$U = 10.5$$

$$A = 300 \times 350 = 10,500$$

$$W = 700$$

$$N = \frac{F \times A}{U \times W} = \frac{1.0 \times 10,500}{10.5 \times 700} = 14.3 = 15 \text{ floodlights}$$

Note: When decimal answers are obtained, take next highest whole number.

- (8) Final step is to determine price from price list for the quantity needed of the floodlight selected.

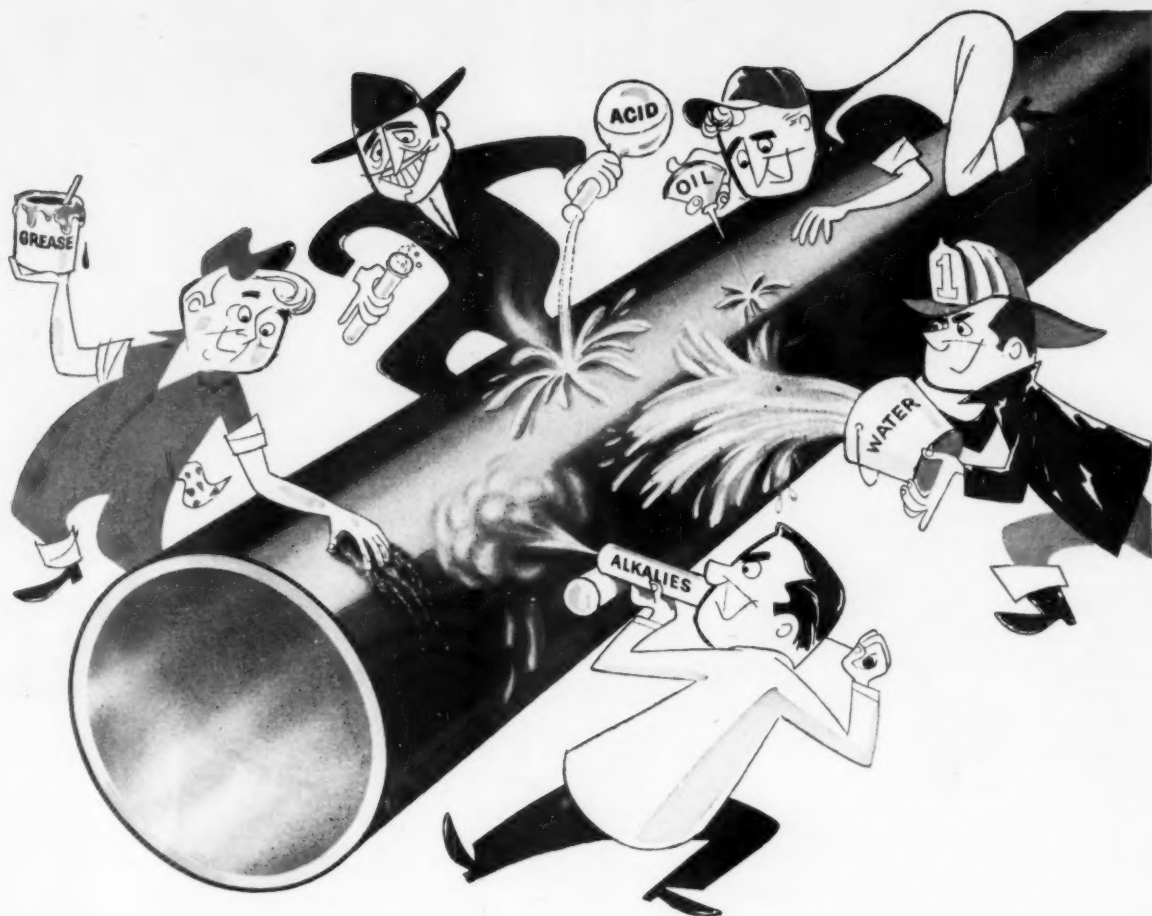
For our example: A floodlight with a standard base and wide-spread lens and specular reflector has a list price of \$170.00. Thus, the cost of floodlights would be— $15 \times 170 = \$2,550.00$ at list price level.

To this will have to be added the costs of lamps and ballasts and other incidental costs.

It should be understood that the chosen unit, as described in the preceding paragraph, is not necessarily the one that will do the best overall job. The normal installation usually consists of several different sizes of floodlights mixed together. But we have determined the approximate price of the floodlights in a very few minutes, and now know whether the selected footcandle level is economically practical. If it is, then more elaborate work is needed to decide the exact floodlight size and lens combinations required to obtain the most uniform illumination. Note a total of 15 floodlights was obtained in the above example, whereas 12 of this size unit and 4 smaller units would be more desirable for a 4-pole installation. It is always desirable to plot the beam spread layout. However, the price should be, within reasonable limits, the same as calculated above.

In order to make the actual layout, each fixture must be considered individually. First determine the point at which the center-line of the beam strikes the ground, then determine BCP of unit, and select unit, as before. Then determine area covered in both directions by using one half of the horizontal and vertical beam widths given in the manufacturer's data for the particular floodlight. Then repeat for an adjacent area, continuing until the entire area is covered. This method of using half the beam widths tends to give even intensity over the entire area.

For areas where the projection distance is greater than 500 feet, a check should be made using incandescent floodlights. This may result in a better lighting job and a savings in initial cost.



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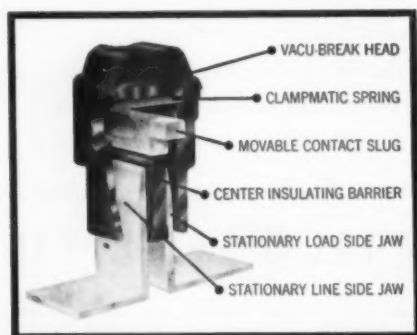
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HEAT BETTER ELECTRICALLY

Questions on the Code

Answered by:

B. A. McDONALD, New York Board of Fire Underwriters, Rochester, N. Y.
B. Z. SEGALL, Consulting Electrical Engineer, New Orleans, La.

GLENN ROWELL

The familiar "G.R." signature on many of the Code Answers printed on these pages in the past will no longer appear. On May 14, 1958, death cut short the career of Glenn F. Rowell, electrical engineer, Fire Underwriters Inspection Bureau (Minneapolis), and consulting editor, Electrical Construction & Maintenance.

The electrical industry has lost a tireless proponent of safe wiring practice. Although his fertile mind and facile pen have been silenced, his practical approach to development and better understanding of electrical safety regulations will live on. All who have known Glenn personally, or through his Code work, have gained from that experience.

Aluminum to Copper Connections

Q. I am interested in knowing the advisability of using aluminum conductors with our present switchgear. I have been a little dubious whether the aluminum to copper (wire in copper connectors) would prove satisfactory over the long pull. I would appreciate your comments on the use of the new service entrance cable with aluminum conductors.—C.R.A.

A. There are several reasons why an aluminum conductor should not be connected to your present switchgear which is provided with cable lugs or terminations designed for copper conductors. When such lugs or terminations are built into the equipment there is a problem. If however the copper lugs may be removed and replaced by UL approved aluminum lugs the problem is simplified.

In the May 1957 issue of the *News Bulletin*, which is a publication of the International Association of Electrical Inspectors, a very informative article, under the name

of M. D. Bergan of the Thomas and Betts Company, covers in considerable detail the various factors which must be considered when aluminum and copper conductors are connected together. A brief summary of this article indicates that only aluminum connectors should be used with aluminum conductors. A copper connector will not function properly with an aluminum conductor due to the lower expansion rate of copper. On the other hand, aluminum connectors will work with copper conductors when they are properly designed. The Underwriters' Laboratories have investigated this problem and list several connectors which are approved for aluminum conductors identified by the letters "AL". When the connector is suitable for both copper and aluminum, it is identified by the letters "CU-AL".

Since it is beyond the scope of "Questions on the Code" to cover all of the details involved with your question, I would suggest that you contact the manufacturers' representative in your area who handles UL approved connectors for aluminum conductors. He will be able to observe the switchgear in question and advise the correct procedure to follow. There is a problem and it should not be discounted if we wish to obtain non-hazardous and effective operation. I also believe that you could obtain a copy of the May 1957 edition of the *News Bulletin* of the IAEI for \$1.00 by application to the International Association of Electrical Inspectors, 612 N. Michigan Avenue, Chicago 11, Ill.

Insofar as service entrance cable with aluminum conductors is concerned, there is no occasion to question its ability to perform properly provided the proper connectors are used. The terminal points usually are at the service drop and the meter cabinet. In some cases the electrical utilities are using service drops composed of aluminum conductors. In such cases we do not have the electrolytic action which results when two unlike metals are in contact with one another and moisture is present. When two unlike metals, such as copper or zinc, are connected together in a moist or damp location, electrolysis may be prevented by using an inhibitor

such as a good grade of grease or vaseline, and the connector itself should be approved by UL. As previously stated, the many considerations involved are covered in the article published in the *News Bulletin* of the IAEI.—B.A.McD.—7/58/1

EMT

Q. Does Section 3736b apply to thinwall?—B.F.R.

A. I would say that this does apply to EMT (thinwall).

For your information there are available fittings with these insulated surfaces which will comply with these requirements. The Appleton Electric Co., to mention only one company, has a complete line of EMT connectors with "insulated throats" for all sizes of EMT; i.e., from $\frac{1}{2}$ in. to 2 ins. inclusive.—B.Z.S.—7/58/2

Cellular Concrete Floor Raceways

Q. What are the requirements for wires in precast concrete?—B.F.

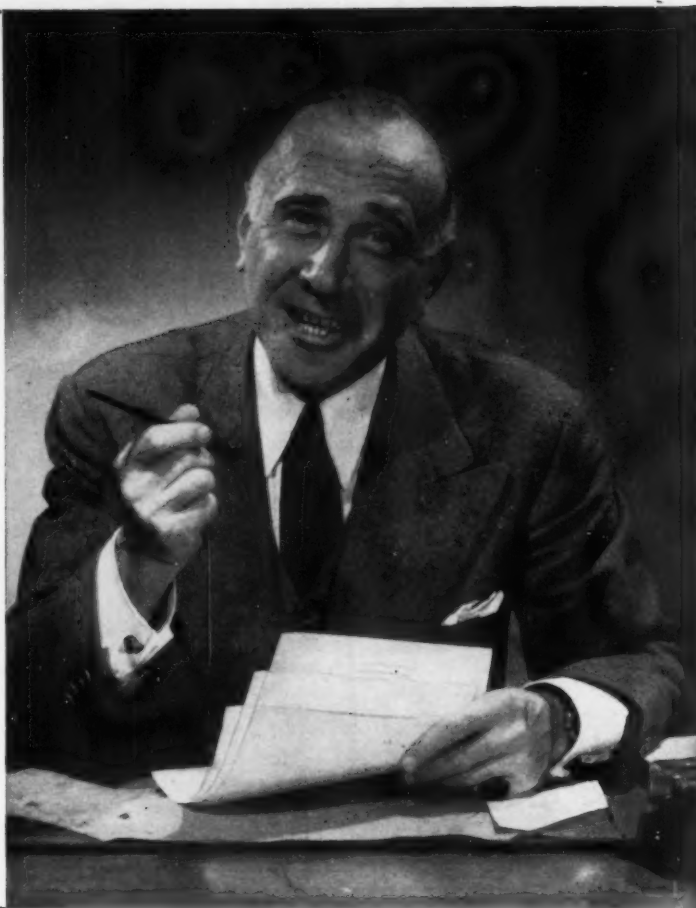
A. I am assuming that you have in mind the raceways of the subject title shown above. These rules are covered in a new article of the code, viz. Article 358 titled as shown above.

Basically, the cells are precast concrete slabs. The interconnection between these spaces is accomplished by means of approved metallic "header ducts". Connections from these ducts to the various cabinets, etc., is made by means of approved metallic ducts and fittings. All junction boxes are metallic and are installed in the header duct systems.—B.Z.S.—7/58/3

Multi-Wire Branch Circuits—Color Code

Q. In Section 2112, Color Code, we would like to have your interpretation on five-wire circuits. Is the yellow wire considered as a second neutral? The code is not very clear on this point.—E.T.O.

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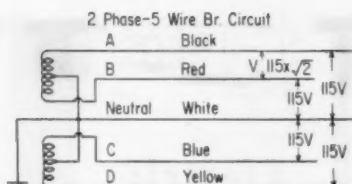
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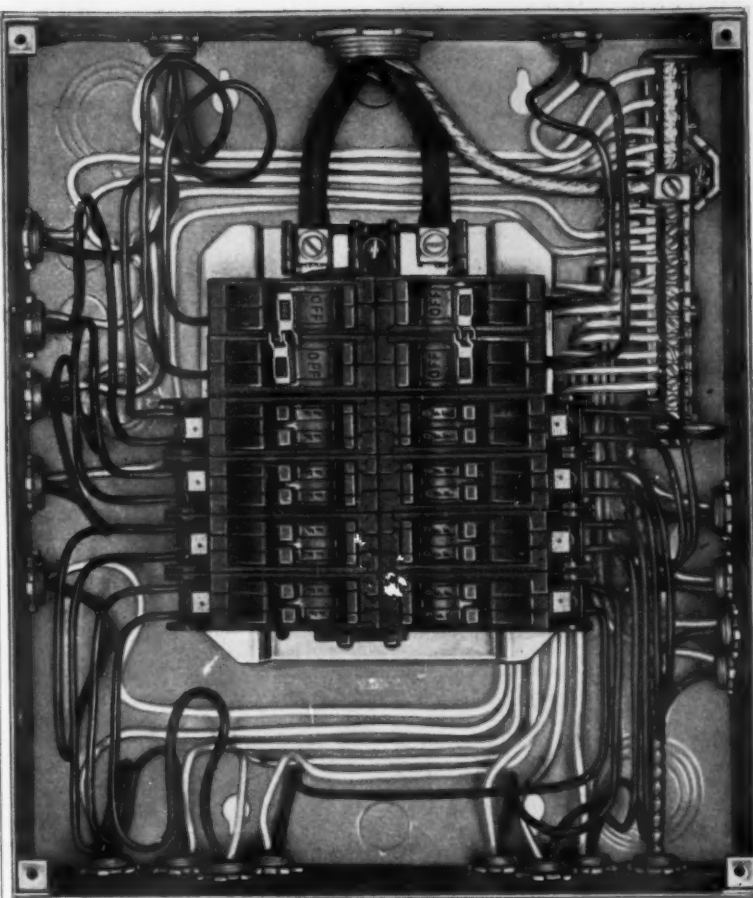
A. As shown in the illustration, the 5-conductor, multi-wire branch circuit covered by Section 2112 concerns a 2-phase system of distribution. According to the definition of a multi-wire branch circuit (Section 2112) this circuit consists of four ungrounded conductors, A, B, C and D, and one identified grounded conductor. The grounded conductor must be identified by a white or natural gray covering as required by Section 2006. The ungrounded conductors of the circuit must be identified as shown. The yellow conductor is a phase wire, which is ungrounded and is not a neutral conductor as covered by Section 2111.—B.A.-McD.—7/58/4

Exit Signs

Q. The Fire Marshal Section of the NFPA is beginning to require new "Exit" signs to be green and not red. This is so in Birmingham and in more and more cities. Since electric contractors usually install such signs, would it not be more practical to include it in the Electrical Code?—R.P.

A. With reference to the first two sentences of your question I would refer you to the fine print note appended to Section 5304 of the Thirteenth edition (1956) of the NFPA booklet No. 101, Building Exits Code. As noted in this paragraph of this Code both colors have had some widespread use. It has been attempted to establish "red" as the required color but this led to quite some difficulties because of the prevalent use of both colors. At present this "advisory document" recommends no specific color since both colors will have their staunch backers. Furthermore, it is possible that some locations may require some color, other than red or green, to provide better visibility.

As to the second part of your question, here again we are confronted with the eternal dilemma of the inspector. I have pointed out from time to time in the various discussions in this column the need for the inspector to familiarize himself with the collateral material



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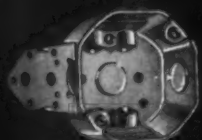
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which will not be found in the National Electrical Code but which he, the inspector, will need in his work of electrical inspection.

Yes, it may be very nice to have all this material between the covers of a single volume, but there is a practical side to this problem; i.e., how big a book can we successfully deal with? We have had instances where a separate code or standard, after some time, was incorporated at least with respect to its electrical requirements, in the National Electrical Code. The use of the Electrical Sections of NFPA Pamphlet No. 56 regarding hospital operation rooms, is a case in point.

There is much in this Section 53 "Exit Signs" of this Building Exits Code that would be of help to the electrical inspector and the electrical contractor as well as others in the electrical industry. So is there much helpful, and I might emphasize, required material in the many other pamphlets, codes, standards, etc., in the publications of the NFPA, NBFU, NEMA, AIEE, IES, and others. There is just no royal road to knowledge. This electrical business in all its phases is requiring more and more concentration and knowhow than ever before. This of course would be quite a discussion in itself.—B.Z.S.
—7/58/5

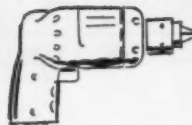
Neutral Feeder Load

Q. The provisions of Section 2203-G of the N. E. Code covers the requirements for computing the load on the neutral conductor of a feeder. Should Note 5 following Tables 1 and 2 be applied to this Section? It is felt that it should be. Why not add it to Section 2203-G as a fine print note?—G.J.

A. For the benefit of our readers, Note 5 of Chapter 10 reads as follows:

"5. Neutral Conductor. A neutral conductor which carries only the unbalanced current from other conductors, as in the case of normally balanced circuits of three or more conductors, shall not be counted in determining current-carrying capacities as provided for in the preceding paragraph. (penalty for more than three conductors in raceway).

"Fine Print note. In a 3-wire circuit consisting of 2-phase wires and the neutral of a 4-wire, 3-phase system, a common conductor carries approximately the same current as the other conductors



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MODEL	C-1	C-3
TRANS. FORMER	75-100 LBS.	75-1125 LBS.
SHOULD PHASE	SHOULD PHASE	SHOULD PHASE
WEIGHT	48 LBS.	100 LBS.

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NO. 7 PHASE

NO. 8 PHASE

NO. 9 PHASE

NO. 10 PHASE

NO. 11 PHASE

NO. 12 PHASE

NO. 13 PHASE

NO. 14 PHASE

NO. 15 PHASE

and is not therefore considered as a neutral conductor."

The provisions of Section 2203-G primarily concern the various factors involved when computing the neutral feeder load. After this value has been established, we obtain the wire size from Tables 1, 2, 1a and 2a of Chapter 10 and Note 5 following these Tables applies to Section 2203-G. I do not believe however that it should be added, as a fine print note to this section, since it is a general requirement. B.A.McD.-7/58/6

Comment—Code Question by T.C. in the May Issue

"T.C. states, 'However, the specs do state that the installation shall conform with the National Electrical Code and the architect is denying us an extra for the barrier'.

"Apparently T.C., an electrical contractor, has the same problems as most of us in other parts of the country. It is *not* the responsibility of the electrical contractor to correct architects' or engineers' mistakes or omissions. They are paid to draw plans and specifications which are functional, economical and complete. Contractors are employed to *install* in accordance with plans and specifications and with applicable codes and should not be held responsible for design. We feel that T.C. should continue his demands for an extra and not allow the architect to use a 'save-all clause' for his protection.

"The NECA Chapter of Santa Clara and San Benito Counties and others in the eleven Western states in the effort of securing better plans and specifications are working on a program which we feel will help the contractor, engineer and owner.

"We will ask that 'save-all' and 'catch-all' clauses be eliminated. The contractors will accept the clause which states the electrical work will be installed in accordance to National Codes and other ordinances but will request that the phrase 'except for design' be added. In other words, the responsibility of producing plans and specifications which are accurate, complete and in accordance with applicable codes shall be that of the architect and engineer."—J. A. Puccinelli, Chairman, Committee on Better Plans and Specifications, San Jose, Calif.—7/58/7



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WHERE TO GET SEALTITE—Electrical wholesalers stock Types U.A. and E.F.† Sealtite in easy-to-handle coils, in black or gray. Be certain you ask for and get the quality conduit marked "Sealtite" on the cover. Buy it in long lengths on reels or in cartons and cut it on the job without waste. Your wholesaler also stocks liquid-tight connectors. Free Booklet S-539 gives full information on Sealtite. Write: The American Brass Company, American Metal Hose Division, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. Sealtite is approved by Canadian Standards Association.

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†Pat. Applied For



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Chicago Limits Changeable Breakers

When the 1958 Chicago Electrical Code is published and distributed, *interchangeable type circuit breakers will be prohibited* in residential wiring and in all occupancies where there is no competent electrical supervisor on duty at all times. All receptacles installed in residential type occupancies or their auxiliary units will be required to be of the groundable type, and receptacles installed in any other type buildings or structures within reach of a grounded surface will also be required to be of the groundable type. These, and many other amendments to the 1954 Chicago electrical code were passed May 28.

The amendments were developed after almost two years of careful study and investigation led by Chief Electrical Inspector William P. Hogan, Jr., and members of the Chicago Electrical Commission.

Specifically, the circuit breaker amendment reads, "Non-Interchangeable breakers and their enclosures designed for use on single phase circuits, single or double pole, and installed in occupancies where there is no competent electrical supervision on duty at all times, shall be so designed and constructed that it will be impossible to substitute a breaker with a larger current rating for a previously installed breaker without making a major change in the construction of the enclosure or its essential parts at the time the substitution is made, except as permitted in (g) of this section. Only approved parts may be used in making the substitution, so that the revised product may be approved. In order to comply with this section the breakers and the enclosures must be approved by the Bureau of Electrical Inspection in addition to the normal approval required. Circuit breakers shall be of such design that it shall be impossible to substitute two or more breakers in a space previously occupied by a lesser number of breakers". Breaker classification as regards current for the purpose of non-interchangeability is listed as follows:

Not over 250 V	Not over 600 V
Amperes	Amperes
0—20	0—20
21—60	21—60
61—100	61—100
101—200	101—200

In regard to spare circuit breaker spaces, the new code states: "In all occupancies other than industrial and commercial where the electrical system is under competent supervision, all unused circuit breaker spaces in circuit breaker panels installed after the effective date of this ordinance shall be so arranged that the largest size breaker which may be installed without a major change to the enclosure will have a rating no greater than 20 amps."

In keeping with the restrictions on spare circuit breaker spaces, the code also includes the following rule on spare fuseholders: "In all occupancies where the electrical system is not under the supervision of a trained mechanic, all spare plug fuseholders in new installations shall be equipped with fuse adapters having a 15-amp rating."

Other provisions set forth in the '58 code further up-grade residential wiring to meet all the requirements of modern electrical living, now, and in the future; and at the same time insure maximum safety and protection. Among these are: Residential occupancies of 850 sq ft shall have a minimum of two No. 2 RH and one No. 4 RH. Residential occupancies of less than 851 sq ft shall have a minimum of two No. 6 RH and one No. 8 RH. Supplies for apartments or units of 850 sq ft or less will require a minimum of two No. 6 RH and one No. 8 RH. The switch or breaker fed by these conductors shall have a 60-amp minimum rating. And for apartments or units of 851 sq ft or more a maximum of two No. 2 RH and one No. 4 RH will be required. The switch or breaker cabinet fed by these conductors shall have a 100-amp minimum rating.

A trend to higher capacity wiring is also reflected in the revised table for calculating load total as listed below:

Dwellings (other than hotels)	
Wattage	Demand Factor
20,000 or less.....	100%
next 100,000	35%
over 120,000	25%
Office Buildings	
Wattage	Demand Factor
30,000 or less.....	100%
over 30,000.....	70%
Schools	
Total Wattage.....	100%

The 1954 Chicago electrical code for dwellings listed 3000 watts or less at a 100% demand factor.

Extra High Voltage Line Planned

A full-scale prototype transmission system to carry power at a maximum of 750,000 volts will be built next year near Pittsfield, Mass., by the General Electric Company.

Participating companies include Western Massachusetts Electric Co., which will take over and operate the EHV (extra high voltage) line as part of its transmission system; Aluminum Company of America, which will supply the steel-reinforced aluminum conductors; and a supplier of steel towers. Stone and Webster Engineering Corp. will be in charge of construction.

Spans will range from 800 to 2200 ft. The largest tower will have two upright members 160 ft high and a horizontal cross-bar 180 ft long. Three "bundled" conductors will be hung at the ends of 20 ft long insulator strings suspended from the crossbar.

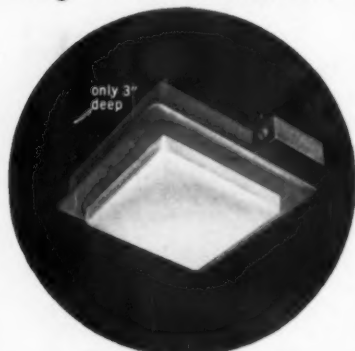
Illinois Inspectors Meet

The Illinois Chapter, IAEI met May 15 and 16th in Moline, Illinois. Frank Stetka, who succeeds the late Charles L. Smith as Electrical Field Engineer for the national Fire Protection Association, led two sessions devoted to Code discussion and inspector's problems. One of these sessions was conducted by an "all industry" panel that was comprised of members representing all segments of the electrical industry and had in attendance as guests, a local group of women wiring advisors from the Iowa-Illinois Gas and Electric Company.

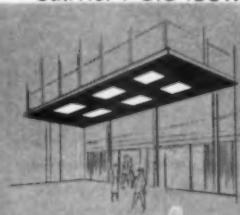
Subjects that brought considerable debate during the open-floor discussion periods were: (1) 3-wire attachment caps and cords for all major appliances; (2) Service entrance equipment and disconnecting means, plus supplementary protection for underground service wires; (3) Location of heating plants and hot water heater, etc. in regard to their proximity to service entrance panels; (4) The 12-ft receptacle rule and how it should be interpreted for application in hotels, motels and sleeping rooms. Although most of these items were discussed at length, no conference

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resolutions were proposed or adopted.

A report given by the Legislative Committee Chairman Stan Cappell, stressed the need for active interest of members on sub-committees.

"Electrical Fault Control" was the subject of an address given by Kent P. Stiner, Bulldog Electrical Products Co. Leslie C. Bieger, representing the Commonwealth Edison Co., presented an informative and interesting slide talk on "Electric Space Heating." "New Developments and Corrosion Protection of Steel Conduit" was discussed by D. W. Rice, Conduit Product Manager, National Electric Products Corp.

NECA District Meetings Held

Three districts of NECA from the Rockies west met in Los Angeles. They were District 6 for the states of Washington, Oregon and Alaska Territory; District 8 for the Rocky Mountain states; and District 9, California and Nevada.

The machine bookkeeping system developed in cooperation with National Cash Register Co. and Ralph Johnson's Estimatic system of estimating, were two of the major features of this convention. Two panels, one on instrumentation and automation, presided over by Contractor Robert H. Warren, and one on lighting, of which Allen Knickrehm was chairman, brought in outside experts to coach contractors

on ways to participate in these two markets.

Paul M. Geary, executive vice-president, NECA, S. J. Cristiano, Matt Sherwod and E. R. Cornish, presented the NECA program and national trends.

Closed Shop Gone, Contractors Must Sell

That electrical contractors must learn to manage and administer better, sell their specialty better and train their personnel better so that they can offer a superior service was the answer given to the National Electrical Contractors Assn. district meetings in the Far West. This answer was to the loss of the closed or union shop prop to their business which they have maintained for years. This condition, outlawed by the Labor Management Act (Taft-Hartley) but never applied to the construction industry until recently, had been given a deadline of Sept. 1 by National Labor Relations Board counsel. The union as a hiring hall and preferential contracts with the union must be revised, the NLRB warned.

To meet and overcome this break from the traditional hiring and bargaining compact between NECA and IBEW, the association's battery of business and management aids were advocated by the national staff officers who addressed the two conferences.

A combined NECA District 5 and IBEW District 7 conference was held at Tucson April 28-May 1 with an attendance of over 400.



FOURTEEN AWARDS in the 1957 International Lighting Competition were won by these Milwaukee contestants. Shown at Milwaukee Electric League Award Luncheon are: (L to R) Edward Allen, Electrical World, representing competition sponsors; Everett H. Schaefer, Wisconsin Electric Power Co. (6 awards); Henry Koether, Wisconsin Electric Power Co.; R. W. Dyer, architect; Edwin Schnoll, Standard Electric Supply Co.; contractor John C. Staff, Jr., Staff Electric Co. (3 awards); B. R. Bunn, Westinghouse Electric Supply Co.; contractor John A. Schneider, Langstadt's, Inc., Appleton, Wis.; August Eckel, Electrical Construction & Maintenance, representing competition sponsors.

It was presided over by G. C. White of Fort Worth, vice-president of NECA, and by A. E. Edwards, IBEW vice-president of District 7. After separate business sessions joint general meetings were held to review business-building methods that could be employed by both union and contractors to improve their market.

NECA Seeks Greater Share of Wiring Market

NECA contractors are not getting what they consider their share of the electrical construction business. Studies indicate that in today's expanding electrical market NECA members' share is less than 25%. And the trend is downward. This was revealed at the recent NECA District 4 (Indiana, Illinois, Wisconsin, Michigan) meeting at the French Lick-Sheraton Hotel, French Lick, Ind.

Additional studies mentioned at the session show that the amount of union-controlled work is decreasing. Today, this is approximately 60% of all work compared to a reported 90% in the past. And this trend is also downward. A shortage of skilled manpower still exists in many areas with little being done to correct this condition.

Non-Union Competition

The increasingly greater amount of uncontrolled (non-union) electrical construction work, particularly in the residential field, is of growing concern to NECA contractors. There was general agreement on this point at the session. Even some so-called "big work" is ending up in this category. Percentages vary in different parts of the country. Some areas are "hit" harder than others.

The growth of non-union competition in Indianapolis, as an example, was recounted by C. Ted Johnson, Watson-Flagg Engineering Co., Indianapolis. Here, no residential wiring, or building, is done by union contractors and over the past 15 years union-controlled work has slipped from 60% to 35% of all construction. Probable reason for the present situation is the lack of interest in the past of the bigger contractors and the union in residential construction.

How to combat it now? Johnson recommended that a joint NECA and IBEW committee meet to analyze the problem and seek a solution. He suggested two ways of meeting this competition. (1)

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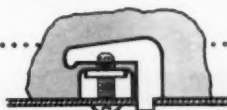
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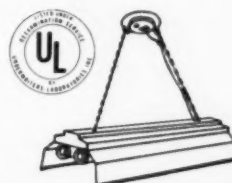
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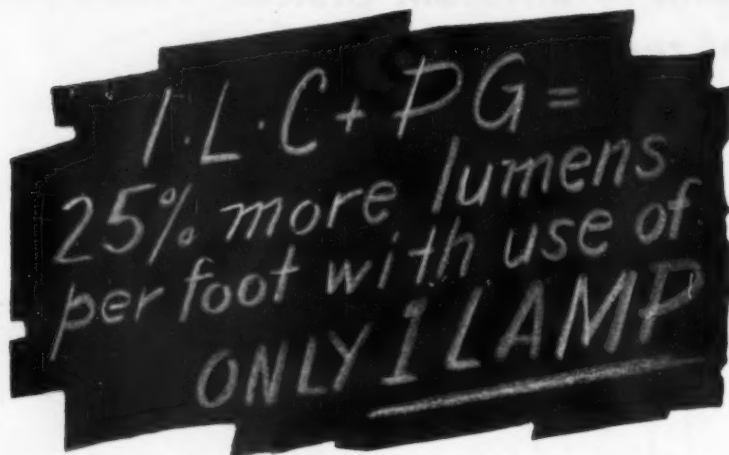
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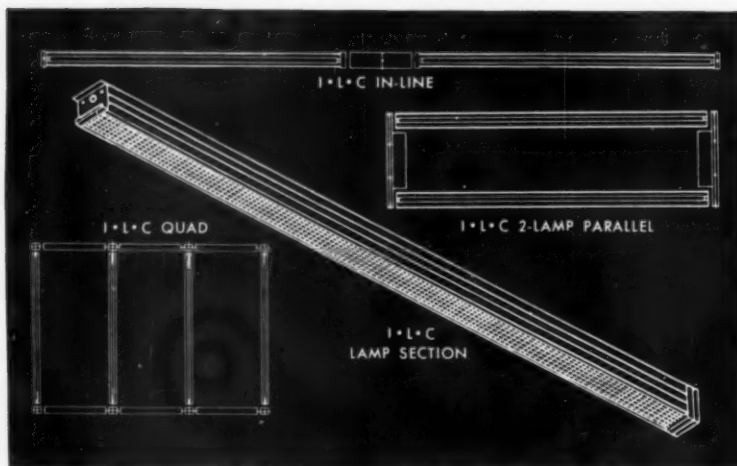
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581 A

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Set up a separate IBEW "B" local with a realistic lower wage scale for house wiring. B men could integrate into the A local only through examination and due procedure—a regulation designed to preclude contractors using B men on a work. (2) If this were not accomplished, Johnson recommended—as a last resort "for self-preservation"—that electrical contractors operate two organizations: one using organized labor; the other using unorganized labor for residential work.

Plan Ahead

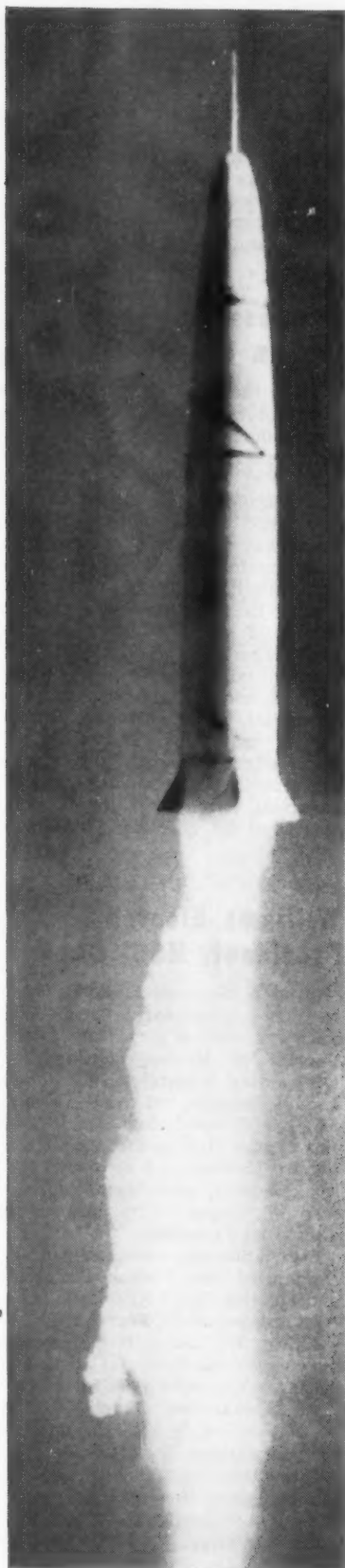
We must find new ways of doing things and add new dimensions to our business thinking, said NECA president O. F. Burnett, Jr. He pointed out that there was an urgent need for long range planning—looking ahead five years or more from now; new dimensions with respect to "net profit"; better public relations; developing and selling our own markets; efficiency of our operation; more attention to employees and how well you get the work done by them with the help of modern tools and equipment; mechanical bookkeeping systems so that you know every day where your business stands. In all your management operations you are going to need scientific methods and a good supply of trained men, he concluded.

Mr. Burnett's talk was one of the highlights of the District 1 meeting held June 2 to 4 at Wentworth-by-the-Sea, Portsmouth, N. H. This district comprises the New England States, New York and New Jersey, of which Harold A. Webster is vice president.

George A. Johnson, Governor, Greater Fairfield Chapter and Theodore D. Bross, Central Connecticut Chapter were chairmen of the sessions.

During the two days, talks were given by Robert H. Hartley, regional engineering manager, Westinghouse Electric Corp., on atomic power; J. M. Corwin, counsel and executive secretary of the Associated Subcontractors of Massachusetts, summarizing subcontract bid and payment procedure on public construction in Massachusetts; Frank W. Crimp, Boston architect, stressing the importance of promoting a better understanding on building projects between the architect and contractor.

W. D. Howell, executive secretary-treasurer, National Electrical Benefit Fund gave a progress report on the Benefit Fund and agree-



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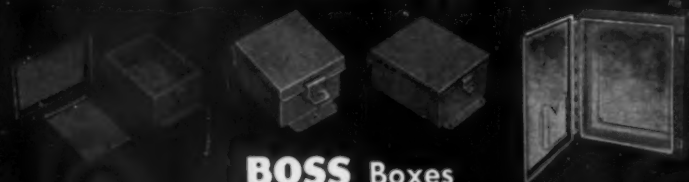
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ment; S. J. Cristiano reported on the NLRB enforcement policy; E. R. Cornish, gave a film presentation on mechanical bookkeeping systems; Floyd Taylor, chairman District No. 1 Research Committee, reported that during the last year they had completed 15 training courses, consisting of four estimating, 10 shop management and one sales training course.

Wholesalers Meet in San Francisco

More than 500 electric suppliers distributors convened in San Francisco June 8-12 to celebrate the 50th Anniversary of the National Association of Electrical Distributors.

Reflecting the meeting's generally optimistic tone, much of the program was devoted to management planning for expanding services to an expanding industry and market. Among the highlights was a panel session of six distributors describing experience-tested operating ideas including Charge-plate invoicing and mechanized business procedures. Dr. Edwin H. Lewis, professor of marketing, University of Minnesota, gave a thought-provoking report on his two-year study of electrical products distribution, sponsored by *Electrical Wholesaling*.

Williams Elected President, MSCI Council

Fred Williams of Fred Williams, Inc., mechanical contractors in Boston, was elected president of the Council of Mechanical Specialty Contracting Industries, Inc., at the annual meeting of the Council Board of Trustees held June 17 in the Statler Hotel, Detroit. Mich. Robert E. Peterson, of the Peterson Company, sheet metal contractors of Kansas City, Mo., was elected vice president.

Mr. Williams succeeds James S. Binder, of the Pfeifer Plumbing and Heating Co., Little Rock, Ark. As a member of the Board of Trustees, Mr. Williams also becomes a member of the National Joint Co-operative Committee of the Associated General Contractors—Council of Mechanical Specialty Contracting Industries. The Council is an organization of associations and contractors in the heating, electrical, air conditioning, plumbing, piping, ventilating and refrigeration fields.

NISA News

The crowd of 75 that attended the chapter officers' luncheon during the NISA Silver Jubilee Celebration was the largest in history. The meeting, arranged by NISA Chapter Affairs Committee Chairman J. Arthur Turner Jr., of Tampa (Fla.) Armature Works, was a model chapter meeting. The officers were given copies of "Let's Have a Chapter Meeting", a manual of procedure for chapter programs and publicity.

The Dow Corning film on Silicones was exhibited at the May 13 meeting of Los Angeles Chapter.

Chicago Chapter's May 13 meeting included a discussion of Moduline Gear Units by Westinghouse's A. L. Grovic and Lee Johnson.

Bill Palmer was elected president of Connecticut Chapter. Michael Phillips, vice-president; Michael Smaga, secretary; Edward Piteo, treasurer. Al Leibowitz, Matt Nau and Joe Piela were elected directors.

Mid-Atlantic Chapter met April 28 at Stafford Hotel, Baltimore.

The new president of Quaker City Chapter is John F. Neihart of Standard Electric Service Corp., Reading, Pa. Al Albertson of Albertson & Son, Red Hill, Pa. is vice-president; Milton Eisenhardt, who operates a shop under his own name in Pennsauken, N. J., is treasurer, and Frank Schaefer of Electrical Maintenance Equipment Co., Philadelphia, secretary. Mr. Albertson is also chairman of the program committee.

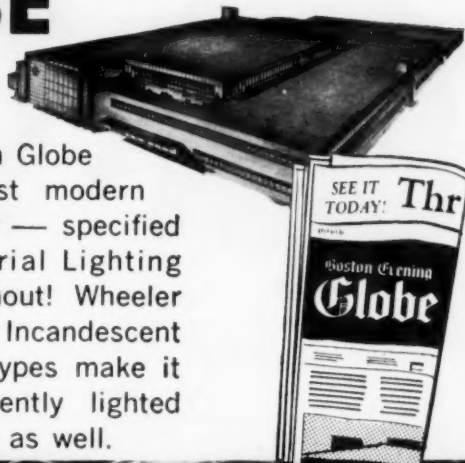
Southwestern Chapter held its spring meeting in New Orleans during the Silver Jubilee Celebration.

New York Metropolitan Chapter held its monthly meeting on April 17 at Hotel Shelburne.

Ralph Trobaugh is the new president of Mid-South Chapter; Ross Burkett, vice-president; Billy Howard, secretary-treasurer; and Ed Duckett, director.

Henry V. Hayden, of Hayden Electric Co., Columbus, Ind. was elected president of Columbus, Ind. Ivan C. Frakes Jr. of Frakes Electric Service; Frederick McBroom, McBroom Electric; and Burton

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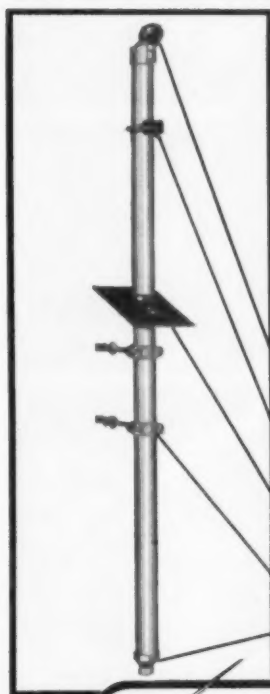
Brook Motors to NEMA Rerate Specifications—same sound engineering and fine workmanship. Technical improvements and modern insulations save up to 15% in weight, provide smaller, more compact motors. Same outstanding performance! Brook Rerate, and Standard Frame Motors, 1 to 600 horsepower available from warehouse stocks in principal cities. Get the cost-cutting facts—send for Bulletin 860!

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**Blackhawk Service Entrance Mast Kits
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5 GOOD REASONS why a Blackhawk kit means a faster, better installation from cable entrance to meter. May be purchased as a complete kit or as separate fittings.

① Slip-fitter service entrance head—Just slip it on over conduit and tighten two set screws. That's all. Made of corrosion-resistant aluminum. Available in a full range of sizes. (Patent applied for.)

② Insulators—Reinforced, durable, well-rounded porcelain secured to metal pipe mounting clamp, galvanized.

③ Flexible Synroflashing—Made of flexible neoprene to absorb vibration. Mast can't work loose, damage shingles, or cause leaks. Won't rot, peel or crack in any weather. Available for 1¼, 1½, 2 and 2½" pipe.

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⑤ Offset reducer—Corrosion-resistant aluminum alloy. Fits 1¼" and 1½" hubs to a 2" or 2½" pipe riser.

The better-made parts in a Blackhawk kit let you do a fast and sound job on every service entrance mast installation. Saves you time, builds your reputation for quality and service. Specify B-I when you buy!

Blackhawk Industries

DUBUQUE, IOWA where the new ideas come from

Hannewald, of Scherer Electric, all Indianapolis firms, were named vice-president, treasurer and secretary, respectively.

Chairman for the coming fall meeting of Southwestern Chapter is T. K. Preddy of Electric Motor Repair Co., Richmond, Va. The conference will be held Oct. 2-4 at Old Point Comfort, Va.

New president of King Coal Chapter is John Eggiman. Ralph Fuhrman was elected vice-president and George Byars, secretary-treasurer.

The first meeting of Great Lakes Chapter of NISA ever to be held in Toledo was held on June 23. Toledo shops are now in the Great Lakes chapter's territory since the chapter boundary revisions, approved at the recent meeting of NISA's board of directors, were put into effect.

Mid-South Chapter met in Montgomery, Ala. on June 22-24. Among the guests was NISA executive v-p Joseph M. Harrington.

More than 75 attended the April 9 meeting of Quaker City Chapter. The group earlier had toured the Pennsauken, N. J. shop operated by Milton H. Eisenhardt.

An interesting program that included "pitches" by five suppliers, each allotted five minutes, was held by Los Angeles Chapter in May. The salesmen, all associate members, were asked to describe their products and services. Participating were: Monte Clark of Tri-State Supply; Leslie M. Swanson, Electrical Specialty Co.; Jack Streeter, W. W. Grainger, Inc.; W. H. Smith, Arrowhead Electric; and William Pendleton, Insulation & Wires, Inc.

The Connecticut Chapter met in Hamden, Conn. June 5 at Weather-vane restaurant.

Bill Saunders of Lenawee Electric, Adrian, Mich. was elected president of Great Lakes Chapter at a meeting April 21 at Carson's restaurant in Detroit. Other officers: 1st Vice-president, Mason Green, Barker-Fowler Electric, Lansing, Mich.; 2nd v-p Otto Werner, Werner Electric, Detroit, Mich.; treasurer, Charles Howard, Howard Electric, Detroit; secretary, Charles E. Smith, Gordon Electric, Detroit.

Directors for two-year terms are Red Watterson of United Electric Motors, Detroit; and James Spaulding, retiring president, of Spaulding Electric Co., Detroit. Other directors are Pat Moran and Harry Kerr.

Newly-elected NISA president Paul Sievert of Sievert Electric Co., Chicago, was honored by his chapter at a meeting on June 10 at Hotel Graemere. At the same meeting representatives of Associated Research Co. presented a demonstration on testing.

Future NISA convention sites include Montreal, 1959; Miami Beach, 1960; Denver, 1961; and San Francisco 1962.

New York Chapter met at Hotel Shelburne May 22 to hear reports of the NISA Jubilee Celebration from several members including national director Alex Shovan, of Industrial Electric Service Co.

William Dreis of Bill Dreis, Inc. was elected president of New Orleans Chapter at a meeting on May 27 at Irwin's Restaurant. Vice-president is Barney Oufnac of Advance Electric; secretary-treasurer is Ed Richardson of Industrial Electric.

Cogan Elected IAEI Secretary-Treasurer

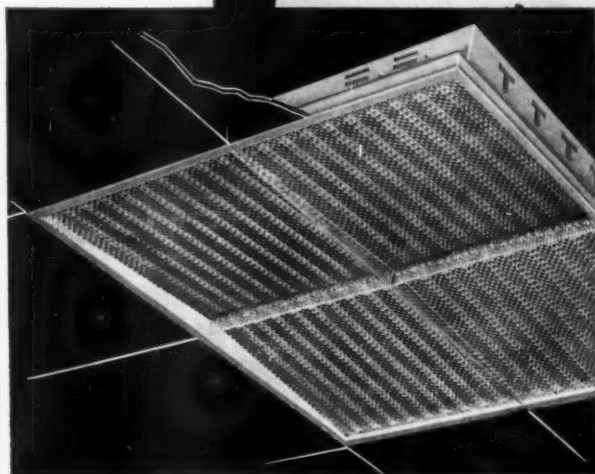
Everett F. Cogan is the new secretary-treasurer of the International Association of Electrical Inspectors. He was elected by the IAEI Executive Council, at its May 18, 1958 meeting in Chicago, to fill the vacancy created by the death of Charles L. Smith last November. Mr. Cogan, former IAEI technical assistant secretary, had been acting secretary-treasurer of the inspector organization in the interim.

Mr. Cogan is a Registered Professional Electrical Engineer (Louisiana), a member of the International Association of Electrical Inspectors, National Fire Protection Association, and American Institute of Electrical Engineers.

Froh Heads Chicago Estimators

Walter Froh of Hecker & Company, Inc., Chicago, is the new president of the Chicago Electrical Estimators Association. Mr. Froh

no light leaks



one of many new engineering features in new

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PLASTIC EGG-CRATE LOUVERS

*Holophane licensee

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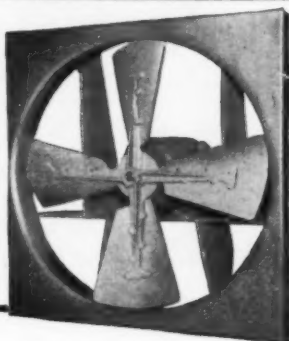


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For low-cost ventilation and exhaust in commercial and industrial jobs, you can't beat "Buffalo" Propeller Fans. "Buffalo" offers a complete line to suit the broadest range of requirements . . . from a small room to a large plant: sizes 24" thru 120" deliver 5,000 to 250,000 cfm. Shipped completely assembled, ready to install and operate. Write for Bulletin FM-315 and prices.

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was elected at the May meeting of the group whose roster includes some 67 electrical estimator-engineers connected with electrical contracting firms throughout the city.

Other officers elected at the meeting were: vice-president—Craig Dunlop, Kelso-Burnett Electric Co.; secretary—William Steele, Kelso-Burnett Electric Co.; and treasurer—J. D. Garrison, Divane Brothers Electric Company, all of Chicago.

Iowa Section Lighting Conference Held

The Iowa Section of the Illuminating Engineering Society held their annual one day summer conference at the Hotel Blackhawk in Davenport, Iowa on May 16th.

Attorney Albert Block, president of the Davenport Community School District Board of Education, speaking at their noon luncheon urged "better lighting in schools" and told the engineers and their guests in attendance "it is their responsibility to see that proper lighting installations are made in our schools". Block further stated "it is to our advantage as well as the children's to see that the right amount of light reaches the desks."

The luncheon program also included the presentation of International Lighting Contest Awards and the National Lighting Bureau's Certificates of Conformance. Lee Widigen, Lighting Representative of the Iowa-Illinois Gas and Electric Co. received two Honorable Mention Awards for his store lighting jobs at the Phillips Plumbing and Heating Co., and the M. L. Parker Co. Mr. Phillips of the Phillips Plumbing and Heating Co., and J. Z. Aponyok representing the M. L. Parker Co., were both presented with NLB's Certificates of Conformance for owner's of award winning entries. William Martens, assistant editor, *Electrical Construction and Maintenance*, made the presentations on behalf of the three McGraw-Hill Electrical Publications and the National Lighting Bureau, co-sponsors of the contest.

Glenn F. Rowell

Glenn F. Rowell, electrical engineer, Fire Underwriters Inspection Bureau (Minneapolis) and consulting editor, *Electrical Construction and Maintenance*, died at his Minneapolis home May 14, 1953, following an illness of several months.

A native of Winona, Minn., Mr.



GLENN F. ROWELL

Rowell attended the University of Minnesota and Bradley Polytech. In 1928 he joined the staff of Underwriters Inspection Bureau (Minnesota, North and South Dakota). Four years later, he was appointed electrical engineer of the Bureau—the position he held at the time of his death.

He was a member of the National Safety Council and the Underwriters Laboratories' Electrical Council; associate member of Underwriters Laboratories, Inc.

He served as the electrical inspector member of the Board of Directors of the North Central Electrical League and was treasurer of that group.

He was also very prominent in Western Section, International Association of Electrical Inspectors activities. For several years he served on the Section's Executive Council; was chairman of Panel No. 16 and a member of the Fire and Accident Committee. He advanced to the vice presidency of the Section in 1955 and the presidency in 1956.

Walter T. Langdon

Walter T. Langdon, 76, executive vice president and general manager of the Langdon & Hughes Construction Corp., Utica, N. Y., died May 8 after a long illness.

Mr. Langdon was also an officer and a director of the Langdon & Hughes Electric Co., founded by him and the late D. A. Hughes in 1911. This electric company was sold to the Gould-Farmer Co., General Electric distributors in Syracuse, in September 1948. Mr. Langdon, however, continued as a director and an officer of the firm. The construction corporation was formed in 1927.

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DATES AHEAD

American Institute of Electrical Engineers—Pacific general meeting—Hotel Senator, Sacramento, Calif., August 19-22; **Fall General meeting,** Penn-Sheraton Hotel, Pittsburgh, Pa., October 27-31.

Illuminating Engineering Society—National Technical Conference, Toronto, Canada, August 17-22.

International Association of Electrical Inspectors—Western Section, Sheraton-Cadillac Hotel, Detroit, Mich., September 7-10; **Northwestern Section,** Billings, Mont., Sept. 15-17; **Southwestern Section,** Southern California, September 22-24; **Canadian Section,** Montreal, Quebec, Canada, October 3-4; **Eastern Section,** October 13-15; **Southern Section,** Miami, Fla., October 20-22.

Western Electronic Show & Convention—Pan Pacific Auditorium, Los Angeles, Calif., August 19-22.

International Association of Electrical Leagues—Annual Conference, Washington, D. C., October 1-3.

Canadian Electrical Manufacturers Association —Annual convention, Sheraton-Brock Hotel, Niagara Falls, Canada, October 8-10.

National Electronics Conference, Inc.—Hotel Sherman, Chicago, Ill., October 13-15.

National Electrical Manufactuerrss Assn.—Annual conference, Hotel Traymore, Atlantic City, N. J., November 10-14.

National Electric Contractors Assn.,—Annual convention and National Electrical Exposition, Adolphus Hotel, Dallas, Texas, November 16-21.

American Society of Mechanical Engineers—Annual meeting, Hotel Statler and Sheraton McAlpin Hotel, New York, N. Y., November 30-December 5.

2nd National Lighting Exposition—Coliseum, New York, N. Y., March 1-4, 1959.

Florida Association of Electrical Contractors—Annual Convention and 6th Electrical Trade Show, Hotel George Washington, West Palm Beach, Fla., October 9-11.



CANADA was well represented by over 30 delegates to NISA's New Orleans convention, one of whom was Hector Roberge from Quebec City.

Among the Manufacturers

Headquarters Announcements

National Electric Products sales offices and warehouses are to be operated exclusively by **Bennett Associates, Inc.**, 2 Gateway Center, Pittsburgh, Pa. The new affiliate company will be headed by R. C. Bennett, who will remain on National's board of directors and executive committee.

Polis Mfg. Co. is new name of J. D. Polis Mfg. Co., Chicago, now a subsidiary of Gregory Industries, Inc.

Unistrut Products Co., Chicago, has established two new subsidiaries: Unistrut Northern California, in Berkeley, and Unistrut Steel Service Co., Atlanta, Ga.

Pieper-Lillard Div., Jasper Blackburn Corp., has moved to 1525 Woodson Rd., St. Louis 14, Mo.

Truco Masonry Drilling Div., Wheel Trueing Tool Co., is new name of Truco Water Swivel Div., Detroit, Mich.

Electro Lighting Corp. is new name of Electro Silv-A-King Corp., Chicago, Ill.

Thomas & Betts Co., Elizabeth, N. J., has acquired the Kent Mfg. Corp. of Newton, Mass., manufacturers of electrical terminals.

Tal Bending Equipment, Inc., Milwaukee, Wis., has been purchased by the Hein-Werner Corp., Waukesha, Wis.

Amplex Corp. has moved to Glen Cove Rd., Carle Place, N. Y.

General Electric Co., Plainville, Conn.—Richard H. Gorman, manager, product planning, Distribution Assemblies Dept.

Oster Mfg. Co., Wickliffe, Ohio—Robert C. Baumgartner, vice president.

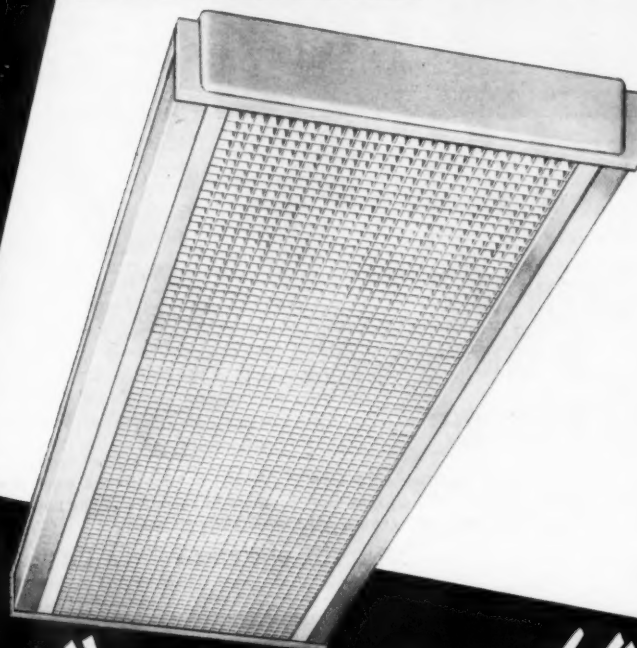
Triangle Conduit & Cable Co., Inc., New Brunswick, N. J.—Edward Simmons, director of sales, Electrical Div.; John E. McAuliffe, chairman of the board; Joseph G. Slater, president; Carl S. Menger and Clyde V. McKay, directors.

Day-Brite Lighting Inc., St. Louis, Mo.—Stanley M. Bixler, senior vice president and general manager; James F. Brennan, manager of plant in Santa Clara, Calif.

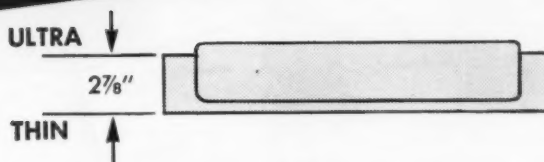
Appleton Electric Co., Chicago, Ill.—Kenneth O. Schneider, vice president in charge of manufacturing; Murray J. Mauritzen, works manager.

G & W Electric Specialty Co.,

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Blue Island, Ill.—Norman O. Kirby, manager of engineering; E. F. Bentley, administrative engineer; A. J. Mowat, plant manager.

Pyle-National Co., Chicago, Ill.—Robert F. Dick, director.

Federal Pacific Electric Co., Newark, N. J.—Daniel W. Boone, director of inspector relations.

Gould-National Batteries, Trenton, N. J.—K. A. Vaughan, manager of product applications, Industrial Div.

Progress Mfg. Co., Inc., Philadelphia, Pa.—Jerome H. Feig, director; Herman Kesler, vice president for marketing and merchandising; Harold Yoskin, vice president; William J. Meinel, director.

Sylvania Lighting Products, Salem, Mass.—Raymond P. Connors, director of national accounts; Horst C. Feige, engineering manager, eastern fluorescent fixture sales.

Wakefield Co., Vermilion, Ohio—F. I. Wilson, vice president—market development; Daniel A. Schisler, sales manager.

Slater Electric & Mfg. Co., Glen Cove, N. Y.—Raymond K. Watkins, vice-president in charge of sales and marketing.

Minnesota Mining & Mfg. Co., St. Paul, Minn.—Maynard H. Patterson, Robert W. Mueller and Lyle H. Fisher, vice presidents.

Johns-Manville, Dutch Brand Div., Chicago, Ill.—William R. Reder, advertising manager.

Thermador Electrical Mfg. Co., Los Angeles, Calif.—Anthony A. Celio, sales manager, Los Angeles district; Richard F. Gamble, advertising manager.

Thor Power Tool Co., Chicago, Ill.—John A. McGuire, executive vice-president; James A. Lind, director.

John C. Virden Co., Cleveland, Ohio—Robert W. Minett, Jr., vice president—marketing.

General Electric Co., Schenectady, N. Y.—K. D. Tobin, manager of product planning, product service and market research, Outdoor Lighting Dept.

Pennsylvania Transformer Div., McGraw-Edison Co., Canonsburg, Pa.—W. Walter Renberg, assistant sales manager.

Crouse-Hinds Co., Syracuse, N. Y.—Robert J. Sloan, president.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—R. E. Persohn, general manager, Gadsden (Ala.) Works.

Diehl Mfg. Co., Somerville, N. J.—Edward Lindberg, Jr., assistant sales manager.

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Wire Pulling Lubricant

Only Y-ER EAS has all these features

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International Resistance Co., Philadelphia, Pa.—George D. Butler, director of sales.

Penn-Union Electric Corp., Erie, Pa.—Fred T. Conboy, vice president—sales; Morris Brenner, vice president—engineering.

Pacific Mercury, Van Nuys, Calif.—Eugene John Freeman, general sales manager.

Thompson Products, Inc.—Stanley C. Pace, vice president.

Line Material Industries, Milwaukee, Wis.—Alvin B. Coyle, director of market research and product distribution; Albert R. Waehner, director of transformer sales; Dennis A. Manning, manager of transformer sales and service; George W. Cooper, director of product management; Carl E. Hoelz, manager of protective equipment; William V. Swan, product manager of power switching equipment; Clifford W. Peterson, product manager of construction materials, porcelain, and outside materials.

Yardney Electric Corp., New York—Maurice Lang, head of Primary Battery Div.

Magnethermic Corp., Youngstown, Ohio—James K. McLaughlin, general sales manager.

Robertshaw-Fulton Controls Co., Columbus, Ohio—M. S. Feltz, marketing manager, Acro Div.

Delta-Star Electric Div., H. K. Porter Co., Philadelphia, Pa.—Glenn R. Smith, sales manager, Electric Service Works.

Regional Appointments

NEW ENGLAND

Benjamin Electric Mfg. Co.: Warren G. Meltzer, representative. Eastern Div., Massachusetts District.

Allis-Chalmers Industries Group: N. W. Landis, manager, Northeast Region.

MIDDLE ATLANTIC

Wolverine Tube, Div. of Calumet & Hecla, Inc.: William N. White, representative in the Greater New York Metropolitan area.

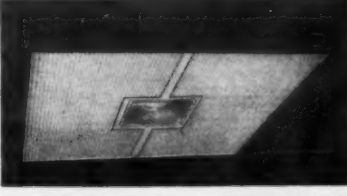
Benjamin Electric Mfg. Co.: Warren J. Prediger, Eastern Division sales manager.

Sylvania Lighting Products: Barry E. Colby, Philadelphia district sales manager.

Weston Instruments, Div. of Daystrom, Inc.: John D. MacNamara, manager, New York district.

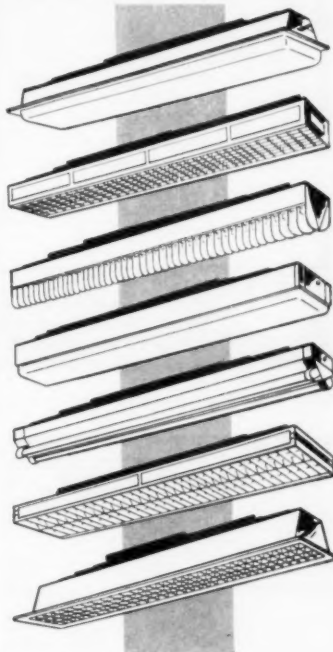
Fasco Industries, Inc.: Joseph Lovett, manager of sales, greater New York-New Jersey area.

Keystone Mfg. Co.: Alfred L.



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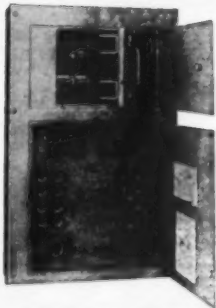
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SAFETY INDUSTRIAL SWITCHES
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Daniels Co., representative in Baltimore, Md.

Allis-Chalmers Industries Group: Clinton F. Kucera, manager, New York district office.

J. A. Weaver Co.: Specialty Electrical Sales Co., representatives for Eastern Pennsylvania, Southern New Jersey, Maryland, Delaware, and the District of Columbia.

Lincoln Electric Co.: Russell S. Hale, district manager of new office in Albany, N. Y.

SOUTH ATLANTIC

Hughey & Phillips, Inc.: Maitland K. Smith Co., Atlanta, Ga. and Birmingham, Ala., Southeastern sales representative.

Keystone Mfg. Co.: Carry Chapman and Co., representative in Greensboro, N. C.; Whitfield Agencies, representative in Hialeah, Fla.

Accurate Mfg. Co.: Frank B. Davis, agent for Georgia, Alabama, and Eastern Tennessee; William Crichton and Associates, Riverview, Fla., representatives in state of Florida.

Benjamin Electric Mfg. Co.: D. M. Woodside, division sales manager, new Southeastern Div.

Silvray Lighting, Inc.: Three new representatives in Florida: Joseph N. Crevasse, Jacksonville area; George N. Jack, Tampa; James A. Foerster, Miami.

EAST CENTRAL

Keystone Mfg. Co.: Colin Finney, representative in Nashville, Tenn.; William E. Jobs, Indianapolis, Ind., representative in Kentucky.

Benjamin Electric Mfg. Co.: David T. Ostrander, representative in Central Division, Ohio District.



ANOTHER TRIO of delegates to NISA's 25th Anniversary convention in New Orleans included Bob Sandman, Sandman Electric, Boston; George Lockwood, Lockwood's Electric Motor Service, Trenton, N. J., and Henry Poulan, Poulan Electrical Co., Monroe, La.

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CALIFORNIAN Gene Quesnoy, Visalia Electric Motor Shop, Visalia (right) agreed with Chicagoans W. C. Luebken and Roy Hyre of Hyre Electric that this year's NISA meeting was one of the best.

Lincoln Electric Co.: Robert W. Thomas, district manager in new Memphis, Tenn., office.

Fisher-Pierce Co., Inc.: J. M. Livingston, representative in Northern Illinois and Southern Wisconsin, office in Chicago.

Edwards Co.: John M. Williams, district manager, Cincinnati office.

Silvray Lighting, Inc.: Sidney Chilton, representative in Western Tennessee and Northern Mississippi, office in Memphis.

Federal Lighting Corp.: Arnold R. Lang, representative in Ohio, Michigan, Indiana, and Kentucky. **Johns-Manville Dutch Brand Div.:** George H. Bills, Chicago regional sales representative.

WEST CENTRAL

Keystone Mfg. Co.: Jones-Philbert and Co., representative in New Orleans, La.

Benjamin Electric Mfg. Co.: Jack A. Chrismer, sales manager, Southwestern Div.; Eric W. McCabe, representative in Southwestern Div., Texas District.

Arrow-Hart & Hegeman Electric Co.: Harold G. Brennan, Jr., New Orleans, representative in Louisiana, Mississippi and Arkansas; Howard Kennedy, representative in Houston, Tex.

Sylvania Lighting Products: John F. Dill, Milwaukee district sales manager; John J. Bannak, sales manager, Minneapolis.

Chelsea Fan and Blower Co.: Schooler-Gorman Co., Kansas City, Mo., representative in Kansas, Oklahoma and Western Missouri; B. S. Forester, St. Louis, Mo., representative in Eastern Missouri and Southern Illinois; H. R. Onacker & Co., Houston, Tex., representative in Texas.

WEST

Chelsea Fan & Blower Co.: Pete Bach Electric, representative in Washington, Oregon, Idaho and Montana.

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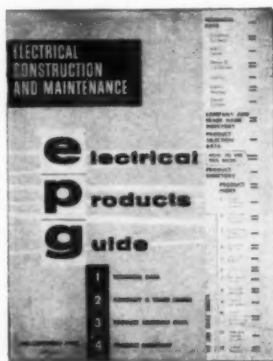
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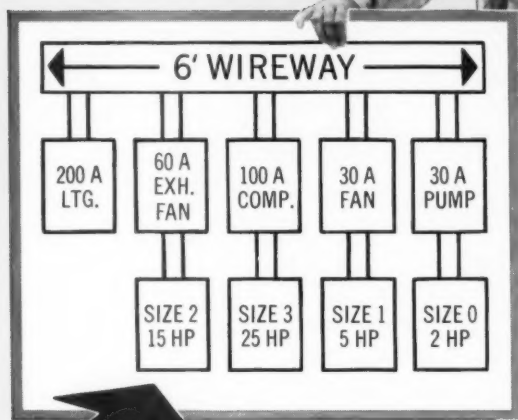


• These manufacturers
advertised their products in
the **ELECTRICAL PRODUCTS GUIDE**

For more complete information, and application data on their lines, refer to the index of Advertisers in the **ELECTRICAL PRODUCTS GUIDE**... the 13th issue of **ELECTRICAL CONSTRUCTION AND MAINTENANCE**.

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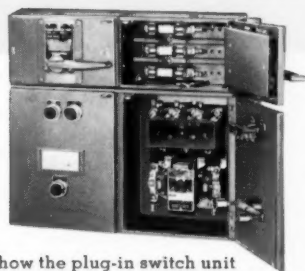
ANOTHER SQUARE D FIRST!



IT TAKES
41 HOURS AND 6 FEET
OF WALL SPACE TO INSTALL
AND WIRE SWITCHES
AND STARTERS LIKE THIS

IT TAKES
12 HOURS AND 30 INCHES
OF WALL SPACE FOR THE
SAME INSTALLATION WITH A
QMB STARTER PANELBOARD

Why mount separate starters and disconnect switches? It costs extra money. It wastes space. It takes a lot more time. QMB Starter Panelboards give you a *safer* installation because you can't open a starter when the switch is ON. They give you a much *better looking* job. Since they can even be *flush* mounted, they offer a lot more installation *flexibility*. QMB panelboards accommodate reversing and non-reversing starters, sizes 0 through 3. QMB switchboards and unit substations handle sizes 0 through 5. All of them are available, factory-assembled and wired. Or get enclosures, starters and plug-in switch units from your Square D distributor for on-the-job assembly.



Notice how the plug-in switch unit is mounted directly above the starter, permitting interlocking. The starter cannot be opened when the switch is in the "ON" position.

It's easy to order these starter and switch units. See Page S7 in your Square D Digest and order from your distributor.



EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

SQUARE D COMPANY



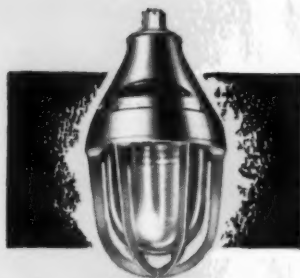
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For dependable security at low
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- where long burning hours without interruption are involved, month in, month out
- where labor cost or trouble of relamping is an important factor
- where maximum lighting output calls for maximum economy in power consumption

The longer life of mercury vapor lamps is well established: 7000 hours, vs. 1000 hours for incandescents. Light output is 2.5 times greater; 55 lumens/watt, vs. 22 lumens/watt for incandescents.



**TYPE EVA Explosion-Proof
Lighting Fixture**

Available with or without guard,
or reflector (dome, deep bowl,
shallow bowl, angle, or high bay)

250 Watt— National Electrical
Code: Class I,
Groups C & D

400 Watt— Class I, Group D

The new EV's place these economies within easy reach. As with all Crouse-Hinds explosion-proof devices, EV's are heavily constructed to withstand the pressure of internal explosions without rupturing. Gas-tightness is *not* a requirement for their safe performance. Flame-tight joints prevent the escape of flames to flammable atmospheres.

- For full information, call your Crouse-Hinds distributor, or write for catalog sheet.

CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

• CONDULET® ELECTRICAL EQUIPMENT (Explosion-Proof and Conventional) • FLOODLIGHTING
• TRAFFIC CONTROL SYSTEMS • AIRPORT LIGHTING and WEATHER MEASURING EQUIPMENT

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